

Updated Status of Western and Central Alaska
Coho Salmon Stocks and Interceptions of Coho Salmon
in Fisheries in the Southern Alaska Peninsula

by

Harold J. Geiger
Jeff Bromaghin
Beverly Cross
Doug Eggers
James N. McCullough

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Alaska Department of Fish and Game
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ABSTRACT

Coho catches increased throughout western and central Alaska beginning in 1979, after a period of low coho catches from 1960 to 1978. These increases in catches appear to have resulted, in part, from reductions in the interception of western and central Alaska coho salmon by high seas salmon fisheries. Catches are now at or near historical levels in nearly all areas. The most important exceptions are the Nushagak and Togiak Districts in Bristol Bay; abundance in these areas has declined. The available information on coho salmon escapements suggests that escapements are stable if not increasing in all of the other areas, and stocks appear to be healthy. Although Yukon coho stocks appear to be healthy, harvest of coho salmon in the Yukon River have been constrained by fall chum salmon abundance in some years.

Coho salmon on the south side of the Alaska Peninsula are harvested from mid July to early August in fisheries directed at other species of salmon. Catches during July and August are of maturing coho salmon that are migrating through these areas. Average annual catches of coho salmon in these "intercept" areas greatly increased after 1979. During July and August in the Kenmore Head to Scotch Cap area, which includes the Unimak District, catches of coho salmon have increased to a peak in 1989, and then decreased, along with fishing effort. For the Shumagin Islands Section, no increasing trend in catches of coho salmon has occurred, although salmon catches are variable and reflect variable fishing effort directed at variable runs of pink salmon. Prior to the 1992 season, the Board of Fisheries took action to restrict harvest in this area in early July. These actions did not take effect until 1993.

The Alaska Department of Fish and Game attempted a stock separation study of coho salmon caught in the post-June South Peninsula area in 1991. The author of the report of that study concluded stock separation techniques would not work on this stock mixture in the near future. In a previous departmental document, the potential for various coho stocks to be in the South Peninsula areas was evaluated based on run timing. All western and central Alaska coho stocks might contribute to coho catches in these areas, based on a run-timing analysis. However, timing information cannot be used to estimate the specific magnitude of stock composition, so great caution should be exercised when attributing actual interception of particular stocks to the respective degree of coincidence in calculated migration timing and timing of catches in South Peninsula areas.

INTRODUCTION

The Board of Fisheries considered the issue of coho salmon catches in the South Peninsula fishery at the 1991-1992 Area M Board meeting. The board took action to restrict coho salmon catches in early July, but the Alaska Superior Court blocked implementation of the resulting management plan during the 1992 season. In 1993 and 1994, fisheries were prosecuted under that plan. In 1995, the board will consider new proposals pertaining to South Peninsula coho fisheries.

To help the board at the 1991-1992 meeting, department staff prepared a report describing stock status, coho interceptions, and possible effects of the Japanese high-seas salmon fisheries (Eggers et al. 1991a). In this paper, we have updated most of the information in the Eggers et al. report using observations from 1992, 1993, 1994 and, in some cases, revised estimates for other years. The Eggers et al. analysis of run timing has been included without revision.

This paper reviews (1) historical abundance of western and central Alaska coho salmon, (2) current status of western and central Alaska coho salmon stocks, (3) South Alaska Peninsula coho salmon fisheries, and (4) what we know of potential stock composition of South Peninsula catches based on run timing consideration.

HISTORICAL ABUNDANCE OF WESTERN AND CENTRAL ALASKA COHO SALMON

Since processing capacity for coho salmon fisheries in Arctic-Yukon-Kuskokwim (AYK), Bristol Bay, and the North Alaska Peninsula have only recently been fully developed, historical coho salmon catches in those fisheries were not necessarily indications of low coho abundance. In contrast, the South Peninsula pink salmon fishery has been operating since the early part of the century. Consequently, the coho salmon catches in the South Peninsula fishery are the longest and most consistent indicator of the historical coho abundance in western and central Alaska (Figure 1). Coho catches were very high during the mid 1920s to the mid 1940s. Catches declined and were very low from the late 1950s through the late 1970s. Catches have been large since 1979 and have consistently exceeded the peak catches of the earlier period. If one assumes that the South Peninsula pink salmon fishery intercepts a mixture of coho salmon from western and central Alaska, then the abundance of coho in the inshore areas of western and central Alaska was very low during the 1960s and most of the 1970s.

To check the consistency of this pattern of inshore abundance of coho salmon with those of other areas, catches of coho salmon for 1960–1994 were compared for five broad geographical areas (Table 2), including Southeast Alaska; Cook Inlet and Prince William Sound; Western Alaska, Alaska Peninsula, Chignik, and Kodiak; Japanese high seas salmon fisheries; and Russian coastal fisheries.

These data demonstrate an increasing trend in catches of coho salmon during the period 1960–1994 for Southeast Alaska, Upper Cook Inlet, and Prince William Sound fisheries; moreover, there has been a 7-fold increase in coho catches in aggregated Western Alaska, Alaska Peninsula, Chignik, and Kodiak fisheries between the early period, 1960–1978, and the recent period (Figure 2). Coincident with the increased coho catches in western and central Alaska, there occurred a parallel reduction in catches of coho salmon in Japanese high seas salmon fisheries (Figure 3), which ended in 1991. The reported catches of coho salmon in Russian coastal fisheries were very stable during the same period (Figure 3).

This pattern of catches suggests that the ocean abundance of coho salmon originating in the North Pacific region west of Southeast Alaska was relatively stable from 1960 through the early 1990s. Thus, the low inshore abundance of coho salmon in western and central Alaska prior to 1979 was likely due to interception of coho salmon bound for western and central Alaska in the Japanese high seas salmon fisheries.

This deduction is also consistent with research, to date, on the origin of coho catches in high seas salmon fisheries (Harris 1987). The few tag recoveries from the early International North Pacific Fisheries Commission (INPFC) tagging effort suggests that Asian stocks predominate throughout the pre-1977 mothership and landbased fishery areas, and that Alaska stocks range only into the eastern sectors which were closed by the 1978 North Pacific Treaty Annex. However, this conclusion is very provisional due to the paucity of data and the fact that many western and central Alaska coho stocks were not heavily exploited by inshore fisheries during the early INPFC tagging effort.

More recent research using scale pattern analysis techniques (Myers et al. 1981; Walker and Harris 1982; Walker and Davis 1983; Walker 1991) to estimate stock composition of landbased fishery catches has shown that western and central Alaska stocks of coho salmon occurred farther to the west and southwest than the earlier tagging effort indicated. The Alaska stocks were predominate in the landbased area during 1981, 1982, and 1990. There are problems with the scale pattern analysis studies due to the lack of comprehensive collections of standard samples from Asian and some Alaska stocks of coho salmon. Harris (1987) concluded, based on research through 1982, that major intermingling of Asian and Alaska coho salmon in the western north Pacific occurs primarily in areas that were excluded from the high seas fisheries by the 1978 North Pacific Treaty Annex. High seas interceptions of North American coho salmon may have been considerable before 1978, especially by the landbased driftnet fishery and in some years by the mothership fishery. However, if Alaska coho salmon migrate west of 175°E, as suggested by scale pattern studies (Walker 1991), there was opportunity for significant interception of Alaska coho salmon after 1979.

COHO SALMON STOCK STATUS BY AREA

Norton Sound, Yukon River, and Kuskokwim Areas

Although comprehensive run assessment programs are lacking, coho salmon returns in AYK appear to be stabilizing in recent years following a period of general increase in the 1980s. Historically, coho salmon commercial fisheries have been managed primarily based on commercial and test fishery catch statistics due to a general lack of adequate inseason run assessment and escapement information. Escapement information obtained by aerial surveys of selected index areas is very incomplete due to poor weather, fall flooding, and inadequate funding for coho salmon monitoring. Some information is available for coho salmon based on sonar and weir projects on a limited number of river systems.

The Kuskokwim area, which includes the Kuskokwim, Kanektok, and Goodnews River Districts, supports the largest commercial coho salmon fishery in AYK, followed by much smaller harvests in the Yukon and Norton Sound areas (Table 1; Figure 4). Commercial harvests in the Kuskokwim area have steadily increased from an average of 208,000 coho salmon annually during 1975-1979 to 663,000 during 1990-1994. During these same periods the average annual harvest has grown from 18,000 to 33,000 in the Yukon area, and from 11,000 to 74,000 in the Norton Sound area, although average harvests have not increased as steadily as in the Kuskokwim area. Growth in harvest is due to the combined effects of fishery development and greater run abundance, although the commercial harvest in some years has been associated with less than optimal escapement indices.

In the Kuskokwim and Norton Sound areas, coho salmon are the target species during August, but in the Yukon area they overlap with more abundant fall chum salmon. Salmon management in the Yukon area during the fall season is based largely on the status of fall chum salmon runs. In recent years coho salmon have accounted for a greater share of the Yukon area fall season salmon harvest due to increasing run sizes and catches of coho salmon (Figure 5).

A sonar project on the Yukon River near Pilot Station has been estimating the upstream passage of all salmon species annually since 1986, except for 1992 when the project was operated for experimental purposes only. The project, however, is generally terminated prior to the conclusion of the coho salmon migration, so coho salmon passage estimates must therefore be considered minimum estimates. Sonar equipment is used to estimate fish passage, and test fishing with a variety of different mesh size drift gillnets is used to estimate the species composition of the passage estimates. Beginning in 1993 sonar equipment,

which operates at a frequency of 120 kHz, has been used. The new frequency provides a greater insonification range and largely avoids the attenuation problems encountered with the former 420 kHz frequency equipment. Minimum estimates of coho salmon passage have ranged from a low of 40,000 and in 1993 to a high of 263,000 in 1988. However, the comparability of these estimates is confounded by annual differences in coho salmon run-timing and annual differences in the operation of the project, including the change in frequency as well as the termination date of the project. A similar sonar project is also operated on the Kuskokwim River near Bethel, but a time series of reliable and complete estimates of coho salmon passage is not yet available.

A weir on the Kogruklu River in the Kuskokwim area and boat surveys on the Delta Clearwater River in the Yukon area provide some of the most complete historical information on coho salmon escapements. Escapement estimates for the Kogruklu River weir during the period 1981–1994 have ranged from a low of 8,500 coho salmon in 1983 to a high of 37,000 in 1982, with incomplete weir information for 1989 and 1990 (Figure 6). District W-2 CPUE, which appears to be a qualitative indicator of subsequent escapement, suggests that had the weir been fully operational in 1989 and 1990, the weir escapement objective would have been reached in 1989 but not in 1990. It should be noted that this is only one spawning stock in the vast Kuskokwim River drainage, and the degree to which the data reflect escapements elsewhere in the drainage is unknown. Escapement indices for the Delta Clearwater River, based on boat surveys of the spawning grounds during the period 1975–1994, have ranged from a low of 2,000 coho salmon in 1976 to a high of 63,000 in 1994; the 1994 escapement estimate is approximately 2.5 times greater than the next largest escapement estimate of 24,000 in 1991 (Figure 6). It should be noted that this is only one spawning stock in the vast Yukon River drainage, and the degree to which the data reflect escapements elsewhere in the drainage is unknown.

Bristol Bay

The commercial harvest of coho salmon in Bristol Bay is documented back to 1893 in the Nushagak District (Rigby et al. 1991). Catch records prior to 1923 reflect the period when traps were legal gear in Bristol Bay and late-season fishing was extensive. With the elimination of traps in 1923 and the advent of late-season closures for the protection of sockeye salmon, the coho harvest was substantially reduced from 1923 to 1953. Catches from 1954 through 1976 remained low, primarily due to the lack of late season markets in the Bay. Most salmon were still canned at the time and the low volume of the coho catch did not economically warrant keeping the large crews employed that were necessary to operate the canning lines. Beginning in 1977, late-season markets became available in the form of freezer-processor ships. Those vessels were able to move freely among districts, and a healthy market for frozen coho salmon resulted in increased prices paid to the fishermen and an expanded fishing effort.

The majority of the Bristol Bay coho harvest occurs in the Nushagak and Togiak Districts (Table 3). However, there has been a noticeable decline in coho abundance in both the Nushagak and Togiak Districts since 1984 (Figure 7). The decline in coho abundance was particularly evident in 1991 when only 5,400 and 4,300 coho salmon were harvested in the Nushagak and Togiak Districts. During the same time period, the Naknek-Kvichak, Eggevik, and Ugashik Districts were experiencing above average harvests (Figure 7). Large catches in those areas were, in part, the result of increased fishing effort and the availability of markets. A number of fishing vessels and processors moved out of the Nushagak and Togiak Districts, where fishing time was reduced to achieve escapement goals, to avail themselves of the more liberal fishing schedule in the Eastside districts. Without quantifiable escapement data, it is not possible to determine whether the increased catches in those systems were the result of large runs or simply a higher rate of exploitation.

Sport harvests of coho salmon have been documented through a statewide sport fish harvest questionnaire since 1977. Sport coho harvests by district from 1989 to 1993 averaged 4,700 fish in the Naknek-Kvichak, 200 fish in Egegik, 300 fish in Ugashik, 1,800 in Nushagak, and 600 in Togiak. In the late 1970s and early 1980s there was a substantial increase in effort and resultant harvest in all districts.¹

Subsistence coho harvests by district (Table 4) from 1969 to 1993 averaged 762 fish in the Naknek-Kvichak, 198 in Egegik, 351 in Ugashik, 5,490 in Nushagak, and 1,056 in Togiak. With the increase in rural population, and the growth in popularity of sport dog mushing, there has been an increase in the subsistence harvest of coho salmon in all districts. The recent 10-year average (1984–1993) coho subsistence harvest in Bristol Bay is 10,472. Because of the very poor return of coho salmon to the Nushagak District in 1991, 1993, and 1994, subsistence fishing was reduced or closed for portions of the season.

Escapement data on coho salmon are very limited in most of the rivers in Bristol Bay. With the exception of the sonar project at Portage Creek in the Nushagak District, there is no daily measure of coho escapement on any of the other river systems. Therefore, fishery managers rely on aerial surveys to index the escapement. Because coho salmon tend to run in the fall of each year, surveys are often hampered by bad weather and resulting high, muddy water. Some coho salmon migrate in glacially turbid rivers, and surveys are further complicated by the duration of spawning that has been documented from August to early December. Most spawning areas have been identified. With the exception of the Nushagak River, escapement estimates are only an index of the abundance. Coho escapement data for the Nushagak and Togiak Districts are presented in Table 5.

For even years in the Nushagak District, which is the primary producer of coho salmon in Bristol Bay, there is nearly a complete overlap in the run timing of the pink and coho salmon. The Bristol Bay even-year pink run has been highly variable, with extremely low runs since the very large 1984 run. Because the run timing of pink and coho salmon overlap substantially, it is not possible to harvest one species without impacting the other.

In the Nushagak, coho salmon tend to hold and mill in the commercial district for extended periods, making them vulnerable to the harvest. Therefore, even a short, fixed fishing schedule can result in a high rate of exploitation and low escapement.

The current biological escapement goal for Nushagak River coho salmon is 90,000 spawners. To allow for upriver subsistence and sport harvests, the commercial fishery is managed for an inriver goal of 100,000 coho salmon past the sonar counter. From 1980 to 1994 coho returns to the Nushagak River averaged 197,000, returns-per-spawner averaged 1.8, and the exploitation rate averaged 44%.

Coho salmon runs to the Togiak District have declined since 1984. From 1980 to 1991, coho runs averaged 129,000 fish, returns-per-spawner averaged 1.5, and the exploitation rate averaged 37% for the Togiak District. Provisional escapement goals for the Togiak River (50,000) and the Kulukak River (15,000) were established in 1984. Evaluation of available spawner-return data suggests the provisional goals are within the range of the estimated optimal escapement goal.

Department biologists and the public are very concerned about the decline in coho salmon runs to the Nushagak and Togiak Districts. The escapement goal for Nushagak River coho salmon was not achieved since 1984, despite a complete closure of the coho commercial fishery and reductions in the subsistence fishery. The numbers of coho salmon escaping in 1992 are unknown.¹ In addition, there is also

¹ Minor editorial changes were made to this paragraph correcting wording used at the 1995 Board of Fisheries version.

considerable concern over the increased catches of coho salmon in the other Bristol Bay districts where estimates of escapements are not available.

Upper Cook Inlet

Upper Cook Inlet is one of the major producers of coho salmon in the state, with an annual commercial harvest averaging in excess of 300,000 fish and an annual recreational harvest in excess of 100,000 fish. Coho salmon are produced by nearly every stream draining into Cook Inlet, with the Susitna River and Kenai River having the largest returns. Escapement is not currently measured in any of the major systems due to budget limitations.

Because of a strong interest in coho salmon among recreational anglers, the *Upper Cook Inlet Salmon Management Plan* directs the department to minimize the incidental harvest of major coho salmon stocks. Because the major Upper Cook Inlet coho salmon runs overlap with runs of sockeye salmon and chum salmon and the commercial fishery is directed at sockeye and chum salmon, meaningful reduction of the commercial coho catch has been difficult to achieve.

The current status of coho salmon appears to be excellent. Harvests in recent years are the highest in the history of the fishery and appear to be within sustained yield limits. Increased pressure from the growing southcentral Alaska recreational fisheries and an increasingly efficient commercial fishery, however, are causes for concern. Development of escapement enumeration technologies and accompanying escapement objectives are considered necessary for the sustained health of Cook Inlet coho salmon stocks.

North Alaska Peninsula

Coho salmon are the third (occasionally second) most important salmon species, economically and numerically, on the North Peninsula. Commercial fishing on coho salmon did not begin on North Peninsula coho stocks until 1948, and then only at limited locations (Shaul et al. 1991; McCullough et al. 1994). In recent years (1985–1994), the average catch has been about 188,000 fish, which is a 7-fold increase over the 1970–1978 average catch (27 thousand) and a 25% increase above the 1979–1984 average (151 thousand) catch (Table 6). Several factors have contributed to this increase, including (1) improved market conditions, (2) more effort, and (3) higher stock abundance. The subsistence harvest has averaged 1,000 fish per year since 1970 (Table 6).

Coho salmon generally enter the commercial fishery the first week of August, peak during the last week of August and the first week of September, and are through by mid September. There are a minimum of 13 documented North Peninsula streams that have coho escapements annually; the most important spawning areas are in the Nelson River, Inik Creek, Meshik River, and Cinder River drainages (Table 7).

Rough escapement estimates are available for recent years (Table 7). These estimates are expanded peak aerial survey counts (i.e., 2.4 expansion factors) and are generally of poor quality due to poor aerial survey conditions (i.e., bad weather and poor visibility) that typically occur along the North Peninsula during the fall. Expanded coho escapement estimates are thought to be minimal estimates due to the protracted nature of coho runs and the potential for undercounting the coho escapement due to poor conditions under which aerial surveys are conducted. Estimated rates of exploitation have averaged 46% during the period 1985–1994 and indicate that North Peninsula coho runs may have been underharvested in some years.

The estimated total escapement to the North Peninsula has averaged 217,000 for the years 1985–1994. Overall, runs are stable and appear to be healthy.

South Alaska Peninsula and Aleutian Islands

Coho salmon are believed to spawn throughout the South Alaska Peninsula and Aleutian Islands management areas. There are 165 salmon spawning streams in the South Peninsula and many more in the Aleutian Islands (at least 335). Coho salmon are thought to spawn in most, if not all, of these streams. However, there are no large, coho-producing river systems in the South Peninsula and Aleutian Islands management areas.

Coho salmon generally enter the commercial fishery the first week of July, peak about July 27, and are through by mid September. Local stocks are harvested primarily from late August to mid September. Catches of coho salmon from 1985 to 1994 in the South Peninsula management area have ranged from 17,000 to 505,000, averaging 308,000 per year. Some areas are managed concurrent with late runs of pink and chum salmon, which have similar run timing, while in other areas fishing is directed at coho salmon. Fishing time is set based on run strength of coho, pink, and chum salmon; however, fishing effort is often low during this period.

While coho escapement likely occurs in nearly all 165 South Peninsula salmon streams, none of the streams are considered major production areas. Because coho salmon spawn late in the year, escapement surveys are often limited by weather, aircraft availability, and operating budgets. Stream escapement counts obtained typically range from less than a hundred to a few thousand (<5,000) fish. Annual South Peninsula coho escapement (i.e., based on a 2.4 expansion of counts of streams surveyed) from 1988 through 1993 have ranged from 2,000 to 124,000 and averaged 40,000 fish. Every stream is not surveyed, and repetitive surveys are not usually conducted; total escapement is very likely underestimated. The year-to-year stability of the coho escapement level in South Peninsula streams is not known. In 1990 effort was directed toward determining the South Peninsula coho escapement where more than 124,200 coho salmon were observed.

Aleutian Islands

Coho salmon are present in limited abundance in the Aleutian Islands. Because of this, few enter the commercial harvest and the escapement is not monitored.

Chignik

The Chignik commercial salmon management area encompasses all coastal waters and inland drainages of the northwest Gulf of Alaska between Kilokak Rocks and Kupreanof Point. The area includes the Chignik River system and approximately 90 other salmon-producing streams. The management area is divided into five districts which are, from east to west, the Eastern, Central, Chignik Bay, Western and Perryville Districts (Figure 8). All species of Pacific salmon are commercially harvested. Purse seines are the only legal gear type for the Chignik area commercial salmon fishery. Typically, between 100 and 103 permit holders are active in the area's commercial salmon fisheries.

The coho salmon harvests have averaged 171,000 during the period 1985–1994 (Table 1). Coho salmon normally enter the Chignik commercial fishery in a bimodal pattern. Early coho salmon appear in late July

during the targeted pink and chum fishery and late coho salmon appear from the end of August through the remainder of the season. The early coho salmon are believed to be non-local stocks and late coho salmon are believed to be local stocks.

Coho salmon spawn throughout the Chignik area; however, most local coho production comes from the Chignik Lakes system. These fish are primarily harvested from mid August to the end of the season in the Chignik Bay District. They are managed concurrent to second-run sockeye salmon, which have similar timing. The amount of fishing time is based on the run strength of both coho and sockeye salmon. Total escapements (Table 8) were estimated by summing post-weir escapements estimated from CPUE data from the Chignik Lagoon fishery (Ruggerone 1989). Chignik Lake coho escapements are at least stable and may be increasing. Rates of exploitation are generally low and have averaged 46% during the period 1973–1994. These rates of exploitation suggest that Chignik coho salmon may be underutilized in some years.

Kodiak

Coho salmon are primarily taken incidental to other species in the Kodiak area, except during directed coho fisheries that occur in terminal harvest locations from early August to late September. There have been dramatic increases in coho catches in recent years (Figure 9). Catches averaged 36,000 from 1960 to 1978, and 224,000 per year since 1979 (Table 1).

At least 171 of the 386 Kodiak salmon producing systems have runs of coho. Escapement estimates for Kodiak stocks of coho from 1984 to 1994 are given in Table 9. These estimates are based on weir counts, expanded weir counts, and expanded aerial survey counts. These escapement estimates are considered minimal because weirs must be taken out before the end of the coho run, and aerial survey conditions are poor during the fall because of high water and poor visibility. Escapement levels have been relatively stable since 1984 and, not counting 1989, rates of exploitation have ranged from 33% to 60%, indicating Kodiak coho runs may be underutilized in some years. Note the low exploitation rate for 1989 (1%) was the result of the *Exxon Valdez* oil spill. Because of the large catches and stable escapement levels, the status of Kodiak coho runs appears to be excellent.

SOUTH ALASKA PENINSULA AREA COHO SALMON FISHERIES

Coho salmon on the south side of the Alaska Peninsula are harvested in mid July to early August in fisheries directed at other species of salmon, while fisheries after September 1 are usually directed at coho salmon. The July and August coho catches occur primarily in mixed stock (i.e., cape fisheries) harvest areas well in advance of the time the coho salmon enter terminal harvest areas. Catches during July and August are of maturing coho salmon that are migrating through these areas, while late August and September catches are believed to be local stocks.

South Alaska Peninsula

Coho salmon are caught incidental to pink salmon in the South Peninsula salmon fisheries during July and August (Figure 10). The bycatch rate of coho salmon for the aggregate South Peninsula fishery was very low during the period 1960–1978 (i.e., 0.0097 coho per pink or 109.1 pink per coho), and increased greatly

since 1979 (i.e., 0.038 or 26.2 pink per coho). This increase in the coho salmon bycatch rate appears to reflect the greater abundance of coho salmon in inshore areas since 1979.

Migrating coho salmon are harvested mostly in two areas during July and August: (1) the Kenmore Head to Scotch Cap area, which consists of the Unimak District and the Ikatan Bay Section of the Southwestern District (Figure 11); and (2) the Shumagin Islands area, which consists of the Shumagin Islands Section of the Southeastern District (Figure 11). Since 1979, an average of 93% of the total annual harvest of coho salmon in the South Peninsula was caught during July and August. Of the July and August coho harvest, an average of 73% was caught in the Shumagins (Table 10). An average of 72% of the total South Peninsula coho salmon (Table 10) and 32% of the total South Peninsula pink salmon harvest (Table 11) came from the Shumagins area during July-August.

Kenmore Head to Scotch Cap

Catches of salmon from the Kenmore Head to Scotch Cap area are dominated by chum and sockeye salmon during early July and by pink salmon during early August. Catches are a mixed bag, with pink and chum salmon dominating in most years (Figure 12). During even years, the area is managed to obtain escapement of local pink salmon. However, openings are usually coincident with openings in other areas of the South Peninsula.

Until 1993 a small but increasing fraction of the South Peninsula July-August coho harvest had occurred in the Kenmore Head to Scotch Cap area (Table 10). The magnitude of salmon catches in the area depends on both abundance and level of fishing effort. Until 1993 there has been a noticeable increase in gillnet fishing effort since 1979 (Figure 13). This increased effort resulted from fishermen electing to move out of other traditional fishing areas, primarily the Port Moller area. Increases in catches of coho salmon have accompanied this increased fishing effort (Figure 14). Since 1992, following the Alaska Board of Fisheries decision to decrease the depth gillnet gear, most drift gillnet fishers have remained in the Port Moller area after June, where the gear fishes more efficiently in the shallow North Peninsula waters.

Shumagin Islands

The post-June catches of salmon from the Shumagin Islands area are dominated by pink salmon (Figure 15). Coho salmon are caught incidental to pink salmon. The fishery is managed to achieve pink salmon escapement goals; whenever pink salmon are abundant, more fishing time is allocated and catches of coho salmon increase with the increasing catches of pink salmon. The magnitude of pink salmon catches in July in the Shumagin Islands area are important inseason indicators of pink salmon run strength. The fishery, during early July and in years of poor pink salmon runs, is managed based on chum salmon catches.

The amount of purse seine permits fishing the Shumagin Islands Section peaked during 1989, and in 1993 decreased to the lowest level since 1978 (Figure 16). The number of set gillnet permits fishing has also decreased from a peak in 1991. Relatively few coho salmon are harvested by set gillnet fishers in the Shumagin Islands Section (Figure 17). Coho catches in the Shumagin Islands Section have been variable. There has been no consistent trend in catches (i.e., catches are not increasing or decreasing) since 1979 (Figure 15). Variation in coho catches in the Shumagin Islands appears to be due to variable purse seine fishing intensity accompanying variable pink salmon run sizes. In recent years, other factors controlling the coho catch are the closure of most South Peninsula fisheries during July 1–19 in both 1993 and 1994 and the presence of immature salmon (which forces the closure of the area when they are abundant).

On average, the timing of coho and pink salmon in the Shumagin Islands Section is somewhat different, with coho salmon arriving slightly earlier than pink salmon (Figure 18). During July, the ratio of coho to pink salmon in the Shumagin catches is generally much higher. The ratio decreases markedly after July 20 as pink salmon move into the area in greater abundance. However, there is substantial variability between years in the relative timing of pink and coho catches in the Shumagin Islands. For example, in 1982 the highest relative catches of coho salmon coincided with peak pink salmon catches.

The majority of coho salmon in the South Peninsula fisheries are harvested in cape fisheries that occur in July and early August in the Kenmore Head to Scotch Cap and Shumagin Islands fisheries. The catches of coho salmon were plotted against the catches of pink salmon for these areas (Figure 19). The bycatch rate of coho salmon is very different for these areas, with a higher rate in the Kenmore Head to Scotch Cap area, but a higher overall catch in the Shumagins.

CALCULATED TIMING OF VARIOUS WESTERN AND CENTRAL ALASKA STOCKS OF COHO SALMON IN THE SOUTH PENINSULA AREA

There is no specific information on the stock composition of coho salmon catches in the South Peninsula and Chignik outside areas. Geiger (1991) examined scale-pattern analyses for this purpose. He assembled a collection of coho scales from 33 populations from Norton Sound to Prince William Sound. After observing scales in the South Peninsula fishery that were not of a type seen in any of the 33 "known" scale collections, he concluded genetic, tag, or scale studies would be inconclusive or misleading until much more is known about stock sizes and potential stocks contributing to these fisheries. There have been no tagging studies of coho salmon conducted in the areas of these fisheries. Because of the magnitude of the South Peninsula and Chignik July-August coho catches and the fact that the increase in these catches, beginning in 1978, is coincident with increases in catches throughout western and central Alaska terminal harvest areas, we assume these catches are a mixture of western and central Alaska coho stocks.

To check for direct and obvious links between the July-August South Peninsula coho harvest and depressed Nushagak and Togiak coho stocks, the estimated Nushagak run size was plotted against coho catch levels in the South Peninsula (Figure 20). No link was detected.

Eggers et al. (1991a) examined the potential for various coho stocks to be in this area based on assumed travel times and the observed timing of catches in terminal harvest areas of these stocks. The assumed travel times were those observed for sockeye and chum salmon in the 1987 South Peninsula tagging study (Eggers et al. 1991b). Data were available for both the South Unimak and Shumagin release areas which, generally, correspond to the area that coho salmon are harvested in the July-August fishery. We have not attempted to redo the analysis using additional data, but we have included important results from the Eggers et al. study (Figures 21, 22, and 23). See Eggers et al. (1991a) for details of the analysis.

In summary, the calculated timing of various stocks in the South Peninsula areas illustrate (1) for each of the coho interception areas there is a great overlap in the timing of western and central Alaska stocks; and (2) the calculated timing is highly coincident with the timing of coho catches in these areas. Based on (1) Eggers et al. (1991a) run-timing analysis, (2) the inability to link South Peninsula catch levels to Nushagak run size, and (3) Geiger's (1991) analysis, we feel it is highly likely that catches in the South Peninsula areas are a complex mixture of stocks and that a potential exists for all western and central Alaska coho stocks to contribute to coho catches in these areas. However, timing information cannot be used to estimate the specific magnitude of stock composition, so great caution should be exercised when attributing

actual interception of particular stocks to the respective degree of coincidence in calculated migration timing and timing of catches in the South Peninsula.

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Table 1. Commercial coho salmon catches (thousands of fish) in western and central Alaska, by management area, 1960-94.

YEAR	Management Area								TOTAL
	KODIAK	CHIGNIK	S. PEN	N. PEN	B. BAY	KUSKO	YUKON	NRT. SD.	
1960	54	7	2	43	16	5	0	0	127
1961	28	3	10	24	20	5	3	14	107
1962	54	1	16	39	39	13	23	9	194
1963	57	9	16	40	41	16	6	17	202
1964	35	2	13	36	36	29	2	0	153
1965	26	9	34	34	8	12	0	2	125
1966	67	15	6	37	33	23	19	6	206
1967	10	9	2	46	53	58	11	3	192
1968	56	2	31	64	93	154	13	7	420
1969	48	18	10	49	81	110	15	7	338
1970	66	15	32	26	14	62	13	4	232
1971	22	14	16	8	12	10	12	3	97
1972	16	19	8	9	13	24	22	1	112
1973	3	22	6	26	57	152	37	9	312
1974	13	12	9	24	43	180	17	2	300
1975	23	53	0	28	46	110	3	5	268
1976	23	35	0	26	26	112	5	7	234
1977	27	17	2	34	107	264	39	4	494
1978	48	20	60	63	94	247	26	7	565
1979	140	99	356	112	294	309	17	31	1358
1980	139	119	274	127	348	328	9	30	1374
1981	121	78	162	155	376	279	24	32	1227
1982	344	303	256	238	619	567	37	92	2456
1983	157	61	127	75	128	249	13	50	860
1984	229	110	310	200	590	830	82	68	2419
1985	284	191	172	176	163	382	58	22	1448
1986	167	115	227	202	170	737	47	36	1701
1987	195	150	225	171	65	479	0	24	1309
1988	303	370	505	234	203	624	100	37	2376
1989	3	68	444	228	240	556	85	44	1668
1990	293	130	307	193	100	445	46	57	1571
1991	323	185	317	215	118	558	109	64	1889
1992	278	296	402	194	191	772	8	105	2246
1993	313	230	212	61	72	687	0	43	1618
1994	296	237	256	241	179	856	4	102	2171
Avg., 1960	122	86	138	99	134	293	26	27	925
Avg., 1960	36	15	14	35	44	83	14	6	246
Avg., 1979	224	171	285	176	241	541	40	52	1731

Table 2. Catches of coho salmon in metric tons (mt) for North Pacific region, broken into five regional areas:

1. Southeast Alaska; 2. Prince William Sound and Cook Inlet;
3. Western Alaska, Alaska Peninsula, Chignik, and Kodiak;
4. Japanese high seas driftnet fisheries; and 5. Russian coastal fisheries.

Year	Southeast Alaska	Cook Inlet, Prince William Sound	Western Alaska, Alaska Peninsula, Chignik, Kodiak	Japanese High Seas Driftnet	Russian Coastal	Total
1960	2,400	1,573	358	6,000	1,690	12,022
1961	3,537	1,217	410	4,300	4,360	13,824
1962	4,347	1,955	606	8,400	4,580	19,888
1963	5,127	2,084	763	9,500	7,020	24,493
1964	5,820	3,106	577	12,500	1,140	23,143
1965	6,179	1,324	509	7,200	2,630	17,842
1966	4,898	1,697	712	4,700	3,140	15,147
1967	3,536	1,640	730	3,800	3,610	13,316
1968	5,528	2,597	1,384	5,600	3,160	18,269
1969	1,975	619	1,050	9,600	3,310	16,553
1970	2,641	1,922	834	5,400	4,510	15,306
1971	3,237	1,604	356	6,800	4,360	16,357
1972	4,800	730	381	7,500	1,910	15,320
1973	2,794	830	837	10,600	2,120	17,181
1974	4,269	755	790	9,700	3,910	19,425
1975	1,399	1,156	958	8,200	3,510	15,222
1976	2,882	1,342	837	7,600	3,470	16,131
1977	3,741	1,413	1,832	3,800	3,790	14,576
1978	5,207	1,879	1,975	5,700	2,370	17,131
1979	4,015	2,100	4,731	2,800	4,550	18,197
1980	3,652	2,053	4,482	3,700	2,260	16,147
1981	4,773	2,849	4,192	3,300	3,510	18,625
1982	7,011	5,296	8,809	5,000	3,700	29,815
1983	6,200	2,974	3,021	2,600	3,470	18,265
1984	7,366	3,878	8,930	3,900	4,660	28,734
1985	9,244	6,563	5,629	1,700	5,830	28,967
1986	9,533	3,689	5,306	1,000	4,880	24,409
1987	4,501	1,746	3,576	1,000	3,450	14,274
1988	3,487	3,570	8,151	600	3,500	19,308
1989	5,760	2,677	5,479	447	3,570	17,933
1990	8,614	3,592	4,929	410	2,190	19,735
1991	6,814	1,236	8,439	286	2,800	19,575
1992	12,099	3,859	7,233	0	4,249	27,441
1993	9,338	2,418	4,852	0	2,738	19,346
1994	19,380	6,570	7,862	0	1,706	35,518
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Avg. 1960 - 1978	3,911	1,550	837	7,205	3,399	16,902
Avg. 1979 - 1994	7,612	3,442	5,976	1,671	3,566	22,268
Avg. 1960 - 1994	5,603	2,415	3,186	4,676	3,476	19,355

Table 3. Coho salmon commercial catch by district, in numbers of fish.
Bristol Bay, 1960-94.

Year	Naknek- Kvichak	Egegik	Ugashik	Nushagak	Togiak
1960	197	2421		13457	65
61	426	3,533	16	16,653	5
62	2,474	3,828	4,553	28,418	11
63	6,823	910	2,743	29,648	1,138
64	3,133	775	380	26,416	5,859
1965	3,053	945	713	2,851	521
66	4,096	1,932	533	11,517	15,864
67	1,175	1,044	1,901	31,517	18,159
68	7,357	6,507	5,771	48,867	24,872
69	17	5,548	9,292	37,799	28,720
1970	53	7,027	1,695	3,688	2,027
71	89	923	469	8,036	3,192
72	402	1,249		3,654	8,652
73	255	2,701	2,307	28,709	23,070
74	916	1,156	4,055	12,569	25,049
1975	43	951	4,595	7,342	33,350
76	1,195	2,321	3,561	6,778	12,791
77	2,883	2,685	3,884	52,562	45,201
78	913	2,256	2,024	44,740	44,338
79	12,355	15,148	17,886	129,607	119,403
1980	7,802	22,537	19,419	147,726	151,000
81	1,229	32,759	30,220	220,290	29,207
82	10,586	74,989	50,803	349,669	133,765
83	7,282	25,954	7,816	81,338	5,711
84	3,209	66,589	68,451	260,310	176,053
1985	10,474	32,667	60,815	20,230	38,636
86	5,824	33,607	25,770	68,568	48,306
87	5,274	30,789	14,785	13,263	1,292
88	29,988	48,981	52,355	52,698	18,468
89	22,668	49,175	33,942	77,077	56,972
1990	16,091	43,897	32,906	7,733	2,690
91	17,527	47,486	42,622	5,574	4,531
92	18,553	47,780	35,794	84,077	5,328
93	1,779	41,603	2,387	14,345	12,615
94	6,841	48,460	19,940	6,814	96,606
Averages					
1960-94	6,085	20,318	17,103	55,844	34,099
1975-84	4,750	24,619	20,866	130,036	75,082
1985-94	13,502	42,445	32,132	35,038	28,544

Table 4. Subsistence catch of coho salmon by district, Bristol Bay,
1969-1993.

Year	District					Total
	Naknek- Kvichak	Egegik	Ugashik	Nushagak	Togiak	
1969	400	0	200	7,100	0	7,700
1970	200	0	0	900	0	1,100
1971	100	0	100	2,300	0	2,500
1972	100	100	300	1,000	0	1,500
1973	500	100	600	2,200	0	3,400
1974	200	0	500	4,700	1,800	7,200
1975	200	0	1,200	4,300	2,800	8,500
1976	600	0	300	2,100	500	3,500
1977	300	200	500	4,500	1,100	6,600
1978	300	200	900	2,500	500	4,400
1979	1,200	100	100	5,200	700	7,300
1980	800	0	200	5,100	1,200	7,300
1981	1,100	0	200	8,700	2,200	12,200
1982	1,000	0	300	8,900	1,300	11,500
1983	900	0	100	5,200	800	7,000
1984	600	300	200	8,100	3,800	13,000
1985	1,103	203	143	6,100	1,500	9,049
1986	650	319	335	9,400	500	11,204
1987	1,106	284	272	6,200	1,600	9,462
1988	813	333	330	5,223	792	7,491
1989	1,927	414	214	8,679	976	12,210
1990	726	331	280	5,919	1,111	8,367
1991	1,056	430	614	10,784	1,238	14,122
1992	1,152	729	397	7,103	1,231	10,612
1993	2,025	905	495	5,038	743	9,206
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Avg. 1969-1979	373	64	427	3,345	673	4,882
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Avg. 1980-1993	1,068	303	291	7,175	1,303	10,195

Table 5. Escapement of coho salmon in the Nushagak and Togiak District
1980-94.

Year	<u>Nushagak District</u>		<u>Togiak District</u>	
	Escapement	a/	Escapement	a/
1980	97,000		96,000	c/
1981	145,000	b/	61,000	d/
1982	263,832		81,000	c/
1983	33,804		e/	
1984	142,841		104,000	f/
1985	82,822		61,300	g/
1986	42,771		30,200	c/
1987	20,219		64,900	h/
1988	131,101		86,330	i/
1989	84,706		e/	
1990	162,853		67,449	i/
1991	39,599		38,160	
1992	no estimate		118,020	
1993	42,742		e/	
1994	82,019		e/	
Average	91,421		53,891	

- a/ Escapement estimates based on data collected from sonar enumeration and on aerial surveys of the spawning grounds: Sonar enumeration has not always covered the complete season: in these cases a proportional method was used to estimate escapement after the sonar operation terminated.
- b/ Sonar enumeration precluded by lack of funding: escapement was estimated from mean exploitation rates from 1980 and 1982-84.
- c/ Includes Togiak and Kulukak River drainages.
- d/ Includes Togiak, Kulukak, Ungalikthluk/Kukayachagak and Nunavachak drainages.
- e/ Aerial escapement estimate precluded by adverse weather and water conditions.
- f/ Togiak, Kulukak, Slug, Osviak and Matogak River drainages.
- g/ Togiak, Kulukak, Quigmy, Matogak and Osviak drainages.
- h/ Estimate of Togiak River drainage derived from sonar enumeration (USFWS) in conjunction with aerial surveys of Kulukak, Osviak, Matogak, Quigmy and Ungalikthluk drainages.
- i/ Togiak, Kulukak, Slug, Osviak, Matogak, Quigmy, Negukthlik and Ungalikthluk.

Table 6. North Alaska Peninsula coho salmon escapement, subsistence, and commercial catch, 1970-94. Values in thousands of fish.

Year	Escapement	Subsistence	Commercial Catch	Total Run	Rate of Exploitation
1970	-	1	26	-	-
1971	-	1	8	-	-
1972	-	1	10	-	-
1973	-	1	27	-	-
1974	-	1	24	-	-
1975	-	0	28	-	-
1976	-	0	26	-	-
1977	-	0	34	-	-
1978	-	0	63	-	-
1979	-	0	113	-	-
1980	-	1	128	-	-
1981	-	1	155	-	-
1982	-	2	238	-	-
1983	-	1	75	-	-
1984	-	1	199	-	-
1985	111	0	168	279	60.2%
1986	164	0	164	328	50.1%
1987	196	0	172	368	46.8%
1988	160	0	234	394	59.4%
1989	258	1	228	487	47.0%
1990	221	1	193	414	46.6%
1991	268	1	215	483	44.5%
1992	254	1	206	461	44.9%
1993	174	1	64	239	27.2%
1994	362	0	241	603	40.0%
Average 1970-1994			122		
Average '85-'94			188	406	47%
Average 1979-1984			151		
Average 1970-1978			27		

Table 7. North Alaska Peninsula estimated total coho salmon escapement, in thousands of fish, 1985-1994.

Location	YEAR										Average
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	
Nelson Lagoon /a	18	57	67	42	77	72	79	48	35	43	54
Ilnik Lagoon /b	36	60	28	52	64	58	65	55	70	34	52
Meshik River /c	40	19	69	42	65	46	55	50	25	150	56
Cinder River /d	13	12	6	24	15	7	22	58	20	43	22
Other	4	16	25	0	38	38	47	43	24	92	33
Total	111	164	196	160	258	221	268	254	174	362	217

a/ Nelson Lagoon includes: David's River, Caribou River, Sapsuk River, Hoodoo Lake, Petterson Creek, and Coastal Lake escapements.

b/ Ilnik Lagoon includes: Ocean River, Willie Creek, Ilnik Estuary, Ilnik Lagoon, and Unangashak River.

c/ Meshik River includes the entire drainage.

d/ Cinder River includes: Cinder River and Mud Creek.

Table 8. Chignik Bay District coho salmon escapement, catch, and run in thousands of fish, 1973-94. a/

Year	Escapement	Commercial Catch	Total Run	Rate of Exploitation
1973	42	21	63	33.3%
1974	35	11	46	23.9%
1975	35	52	87	59.8%
1976	41	34	75	45.3%
1977	43	17	59	28.8%
1978	47	14	61	23.0%
1979	122	43	165	26.1%
1980	68	47	115	40.9%
1981	32	63	95	66.3%
1982	108	127	235	54.0%
1983	29	30	58	51.7%
1984	64	70	134	52.2%
1985	157	156	313	49.8%
1986	107	59	167	35.3%
1987	102	77	179	43.0%
1988	148	92	240	38.3%
1989	80	68	148	45.9%
1990	44	60	104	57.7%
1991	53	56	109	51.4%
1992	28	81	109	74.3%
1993	36	49	85	57.6%
1994	68	71	139	51.1%
<hr/>				
Average	71	58	129	45

a/ 1994 escapement numbers are preliminary.

Source 1973-88 data: Ruggerone (1989)

Source 1988-91 data: Method developed by Parker and Rogers (1984)

Table 9. Estimated total coho salmon escapement, catch, and run, in thousands of fish, for the Kodiak Management Area, 1984-1994.

	Year										
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Escapement a/ Systems With Weirs:											
Karluk	16	38	28	46	13	25	14	35	52	19	23
Red River	2	33	17	16	29	13	29	43	65	2	34
Dog Salmon	1	4	5	8	6	7	7	9	8	5	5
Upper Station	3	5	4	3	5	7	10	6	7	7	5
Akalura	a/	5	3	2	6	4	4	8	2	5	2
Saltery	a/	4	12	11	8	7	3	12	N/A	N/A	2
Buskin River	a/	9	11	11	8	10	7	10	6	7	8
Litnik	8	15	5	16	11	16	13	14	16	7	12
Pauls Bay	4	10	10	5	6	8	4	11	N/A	11	13
Index Escapement b/ Estimated Total	44	124	96	119	92	97	91	147	156	63	104
Escapement c/	145	404	312	388	301	317	218	479	509	205	339
Total Catch	230	284	169	193	303	3	294	325	280	313	296
Run	375	689	481	581	603	320	511	802	789	518	635
Harvest Rate (%)	61%	41%	35%	33%	50%	1%	58%	41%	36%	60%	47%

a/ The weir counts of coho escapement include an estimate of fish passing after weir removal. The post-weir escapement components were calculated by the rate of escapement count change for the last few weeks each weir was operated. The Akalura 1985 coho escapement was determined using the 1986-89 mean escapement distribution. Missing 1984 counts were estimated using the 1985-89 mean escapement distribution. Pauls Bay escapement for 1991 was determined from the average 1984-90 escapement distribution. Karluk and Red River escapements in 1991 are aerial survey counts.

b/ The indexed escapement number is the sum of the coho escapement counted through nine weirs.

c/ The total estimated escapement is the indexed escapement expanded by a factor of 3.26 which is based ADF&G work in 1986 (Holmes 1990).

Table 10. Coho salmon harvests (thousands of fish) by area and time for South Peninsula Management Area.

Year	July - August Harvest		Sept.-Dec. Harvest	Total Post June
	Shumagin	All Other Areas		
1979	314	27	17	357
1980	233	10	30	273
1981	127	14	21	162
1982	206	38	11	255
1983	87	25	15	127
1984	210	90	11	311
1985	109	46	15	170
1986	200	30	6	236
1987	153	50	22	225
1988	347	132	26	505
1989	243	187	16	441
1990	180	102	23	305
1991	144	149	20	313
1992	220	160	35	415
1993	126	71	17	214
1994	139	75	36	250
Average	190	75	20	285
Percent of Total	66.6%	26.5%	7.0%	100%
Percent of July-Aug.	72%	28%		

Table 11. Pink salmon harvests (thousands of fish) by area and time for South Peninsula Management Area.

Year	July - August Harvest		Sept.-Dec. Harvest	Total Post June
	Shumagin	All Other Areas		
1979	2,071	4339	0.054	6,410
1980	1,626	4709	0.154	6,335
1981	1,364	3218	0.000	4,582
1982	1,639	3377	0.000	5,016
1983	900	1871	1.254	2,772
1984	1,787	8882	0.458	10,669
1985	1,627	2697	0.290	4,324
1986	1,498	2240	0.518	3,739
1987	541	650	1.499	1,192
1988	3,336	3467	62.3	6,865
1989	2,027	5063	0.281	7,090
1990	1,106	1239	0.584	2,346
1991	2,160	7817	0.000	9,977
1992	2,296	6819	1.525	9,117
1993	3,329	6514	0.515	9,844
1994	1,135	5513	0.294	6,648
Average	1,778	4,276	4	6,058
Percent of Total	29.3%	70.6%	0.1%	100%
Percent of July-Aug	29%	71%		

Table 12. Weekly catches (thousands) of pink salmon, coho salmon, and ratio of coho salmon to pink salmon in the Shumagan Islands area fishery.
Presented are values for years 1981 - 1994, with an average over those same years.....

Date	1981			1982			1983			1984			1985		
	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk
7/6	30	2	0.07	90	1	0.02	12	3	0.26	77	5	0.07	14	1	0.04
7/13	31	16	0.53	201	18	0.09	17	12	0.70	101	28	0.28	7	3	0.45
7/20	32	15	0.48	284	32	0.11	61	25	0.40	224	43	0.19	144	90	0.63
7/27	302	29	0.09	608	95	0.16	361	33	0.09	580	86	0.15	179	28	0.16
8/3	449	36	0.08	229	40	0.18	329	7	0.02	519	41	0.08	621	41	0.07
8/10	348	9	0.03	206	19	0.09	121	7	0.06	173	5	0.03	510	13	0.03
8/17	172	19	0.11	0	0	—	0	0	—	113	2	0.02	153	3	0.02
Date	1986			1987			1988			1989			1990		
	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk
7/6	38	9	0.24	17	1	0.04	15	1	0.04	50	9	0.18	0	0	0.00
7/13	68	53	0.78	21	13	0.61	16	5	0.35	63	14	0.22	25	10	0.39
7/20	144	53	0.37	95	67	0.71	240	96	0.40	36	10	0.26	28	14	0.51
7/27	368	45	0.12	92	53	0.57	392	93	0.24	653	108	0.17	288	52	0.18
8/3	564	31	0.05	153	17	0.11	1039	68	0.07	790	76	0.10	536	68	0.13
8/10	316	9	0.03	0	0	—	922	46	0.05	397	24	0.06	228	22	0.09
8/17	0	0	—	164	2	0.01	712	37	0.05	37	3	0.07	2	0	0.13
Date	1991			1992			1993			1994			AVERAGE		
	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk
7/6	9	0	0.00	0	0	0.66	—	—	—	—	—	—	25	2	0.12
7/13	2	1	0.56	43	18	0.42	3	5	1.57	3	2	0.81	41	16	0.60
7/20	16	8	0.49	59	7	0.12	375	41	0.11	148	26	0.18	99	74	0.30
7/27	320	68	0.21	607	70	0.11	725	36	0.05	482	44	0.09	307	179	0.12
8/3	785	30	0.04	494	25	0.05	1,096	23	0.02	195	23	0.12	435	160	0.07
8/10	462	8	0.02	849	37	0.04	430	8	0.02	307	44	0.14	269	125	0.05
8/17	474	30	0.06	243	63	0.26	644	12	0.02	—	—	—	136	70	0.05

South Peninsula Coho Catches

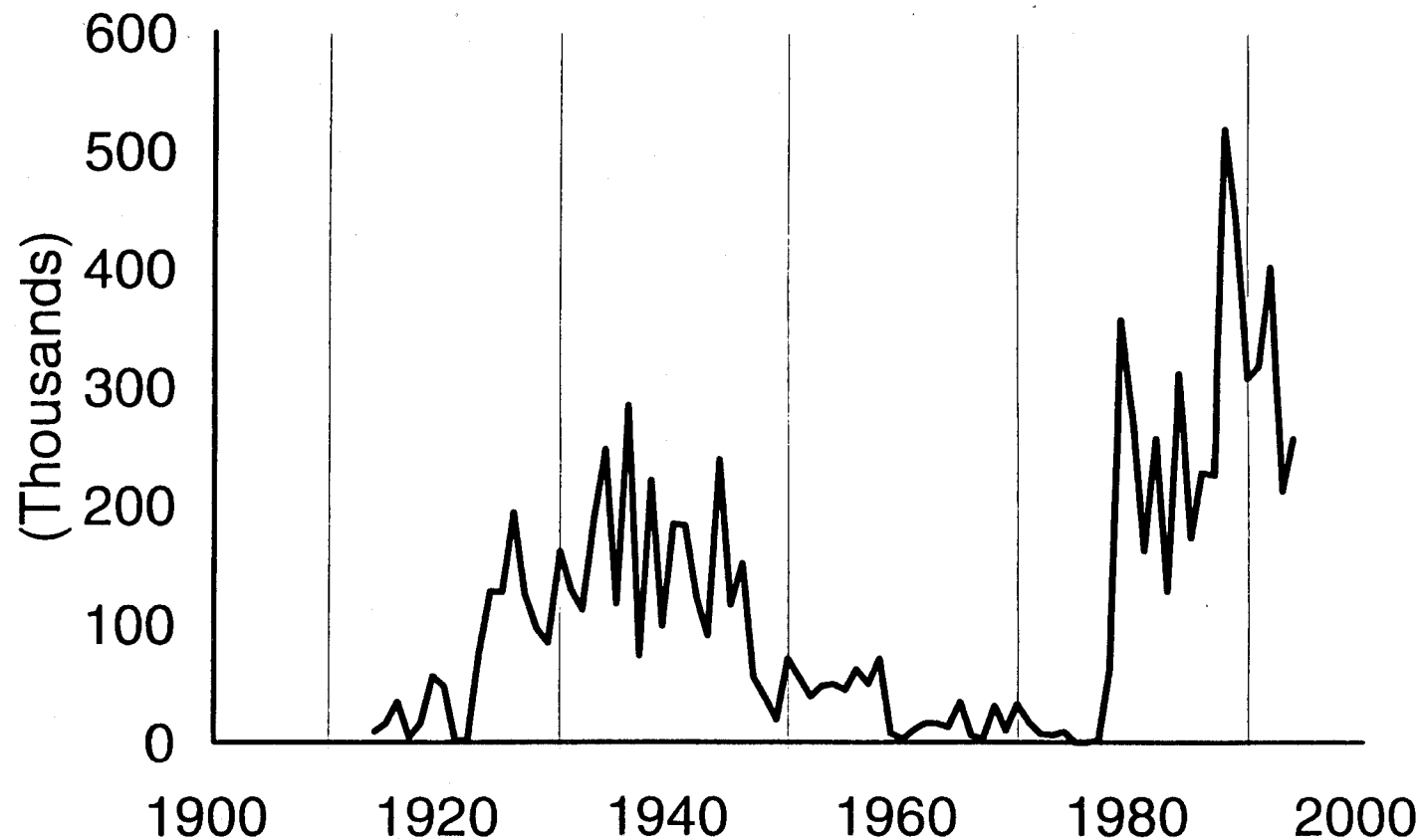


Figure 1. South Peninsula coho salmon catches (thousands of fish) for the years 1914-1994.

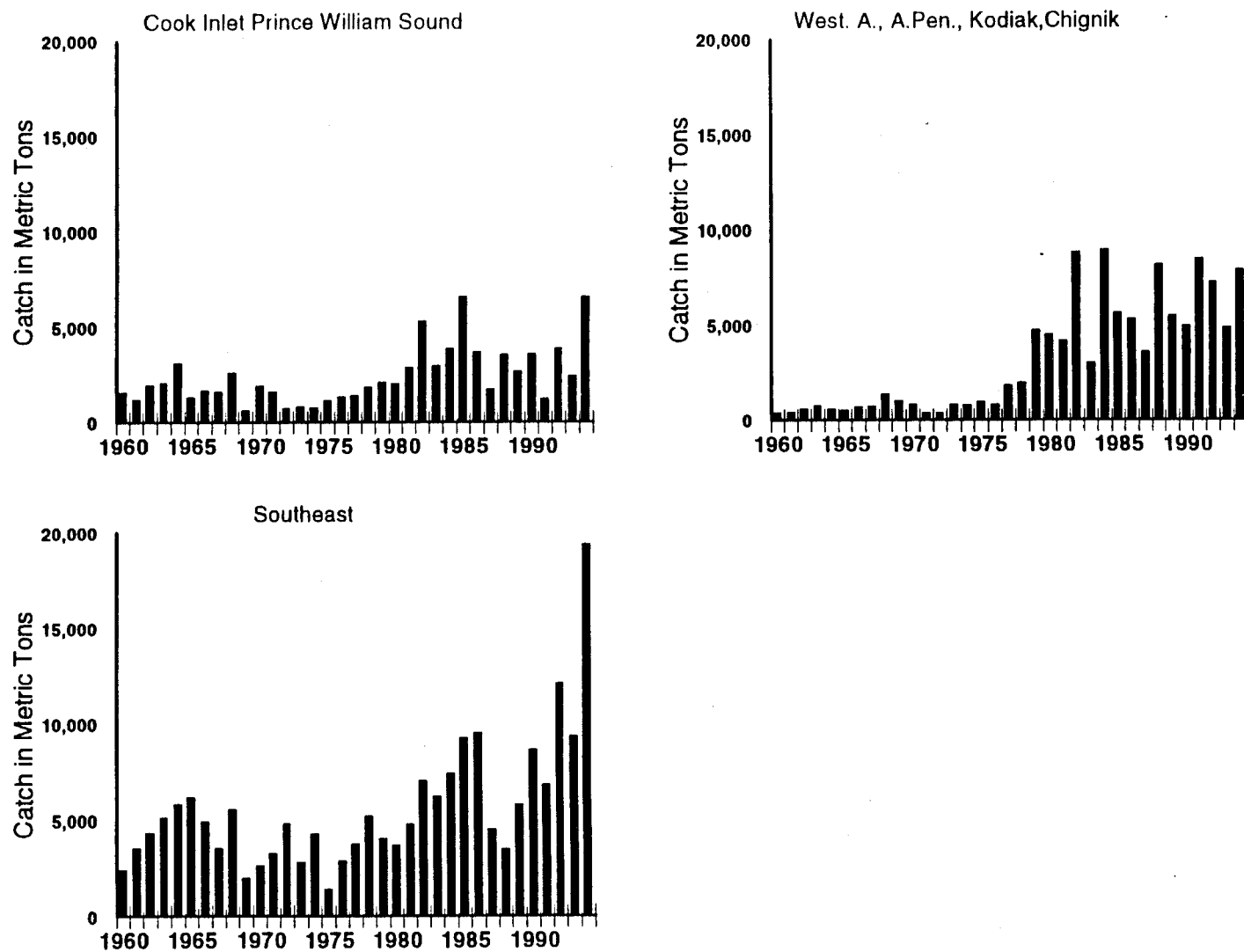


Figure 2. Coho salmon catches (metric tons) in Alaska, 1960-1989, for (1) Southeast Alaska; (2) Prince William Sound and Cook Inlet; and (3) W. Alaska, Alaska Peninsula, Chignik and Kodiak.

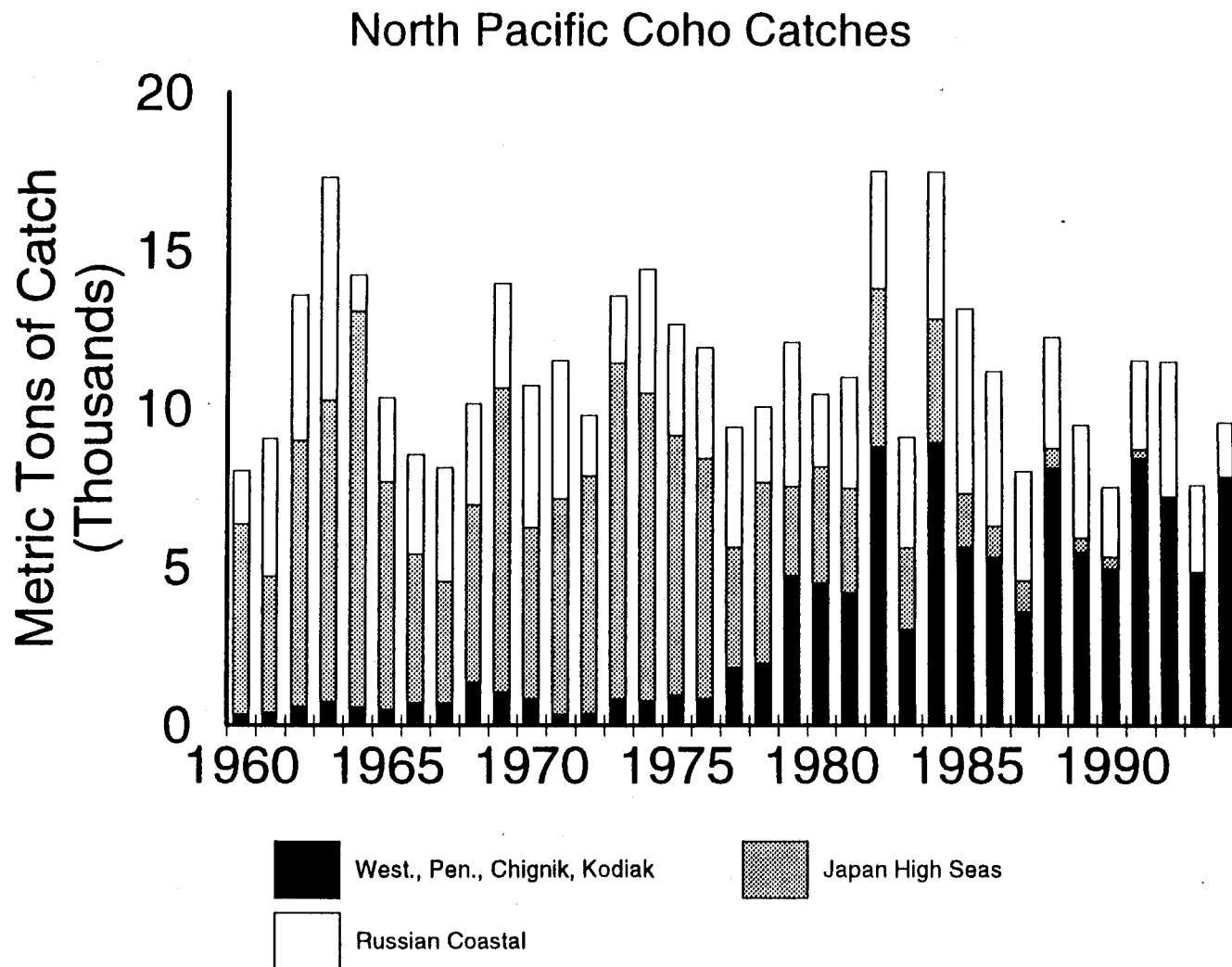


Figure 3. Coho salmon catches (metric tons), 1960-1989, for (1) W. Alaska, Alaska Peninsula, Chignik and Kodiak; (2) Japanese high seas driftnet fisheries; and (3) Russian coastal fisheries.

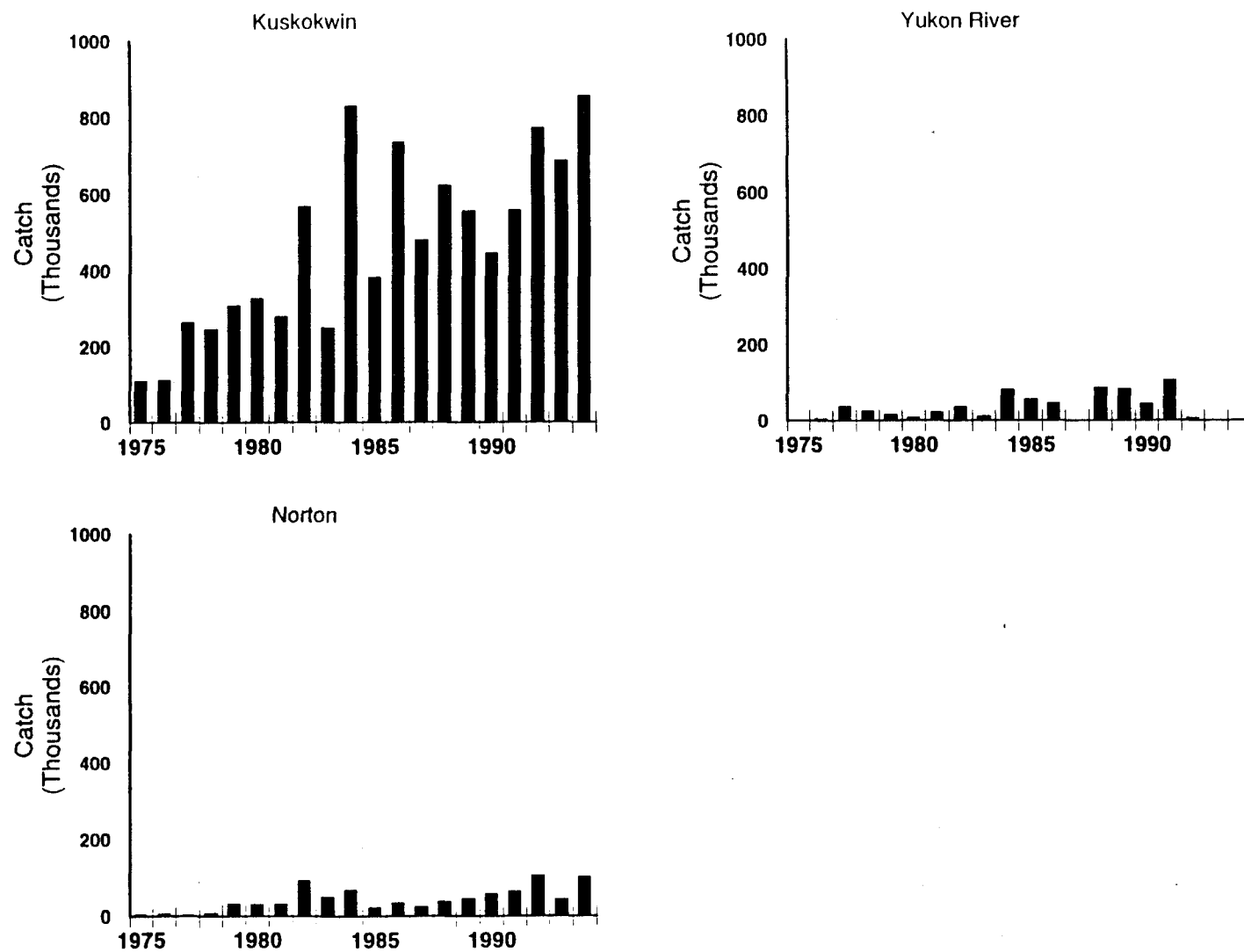


Figure 4. Coho salmon commercial harvest by area in the Arctic-Yukon-Kuskokwim Region, 1975-1994.

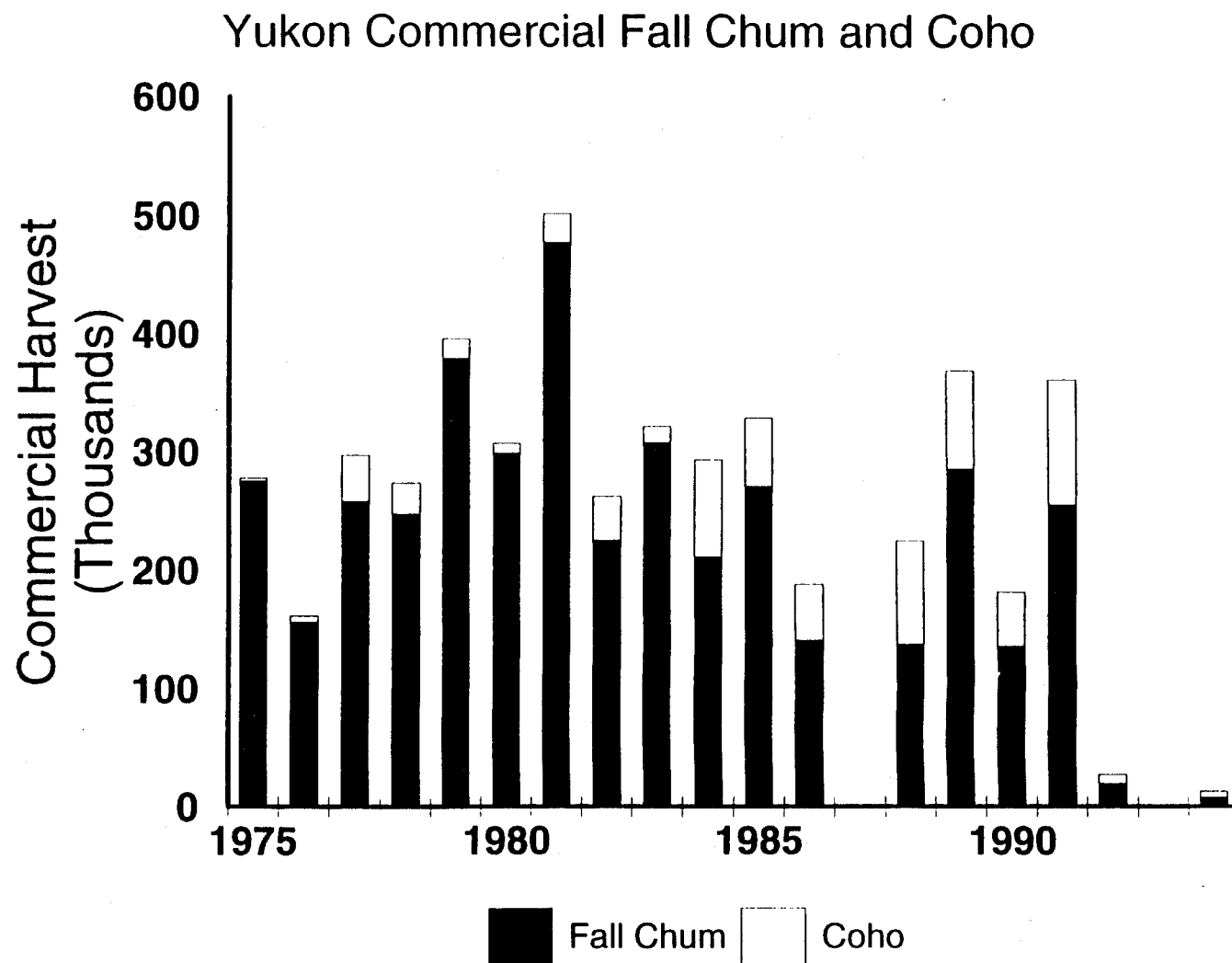


Figure 5. Commercial harvest of fall chum and coho salmon in the Yukon area, 1975-1994.

Kogrukluk and Delta Clearwater Escapements Series

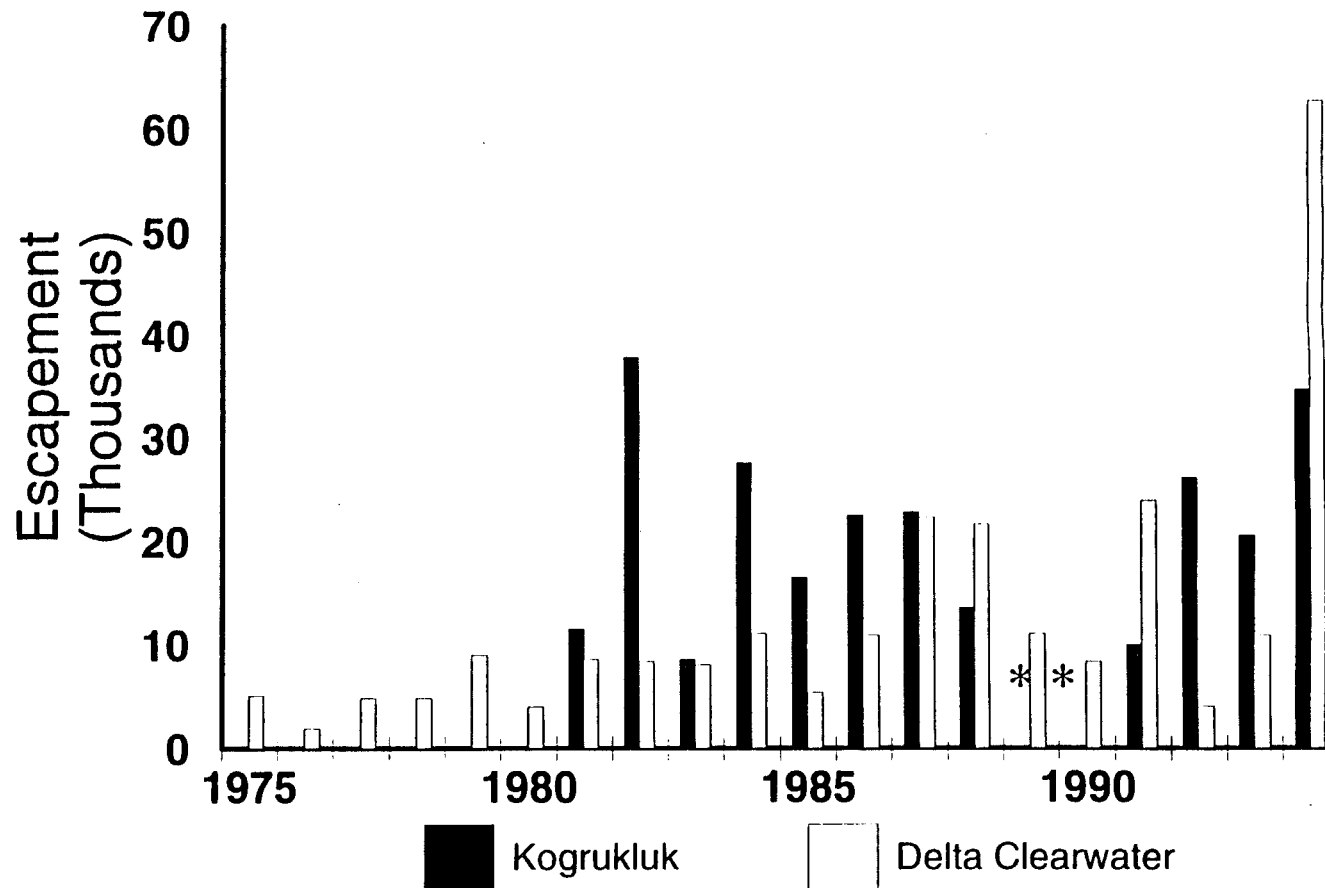


Figure 6. Coho salmon escapement to the Kogrukluk River in the Kuskokwim area, and to the Delta Clearwater River in the Yukon area, 1975-1994.

* indicates missing data.

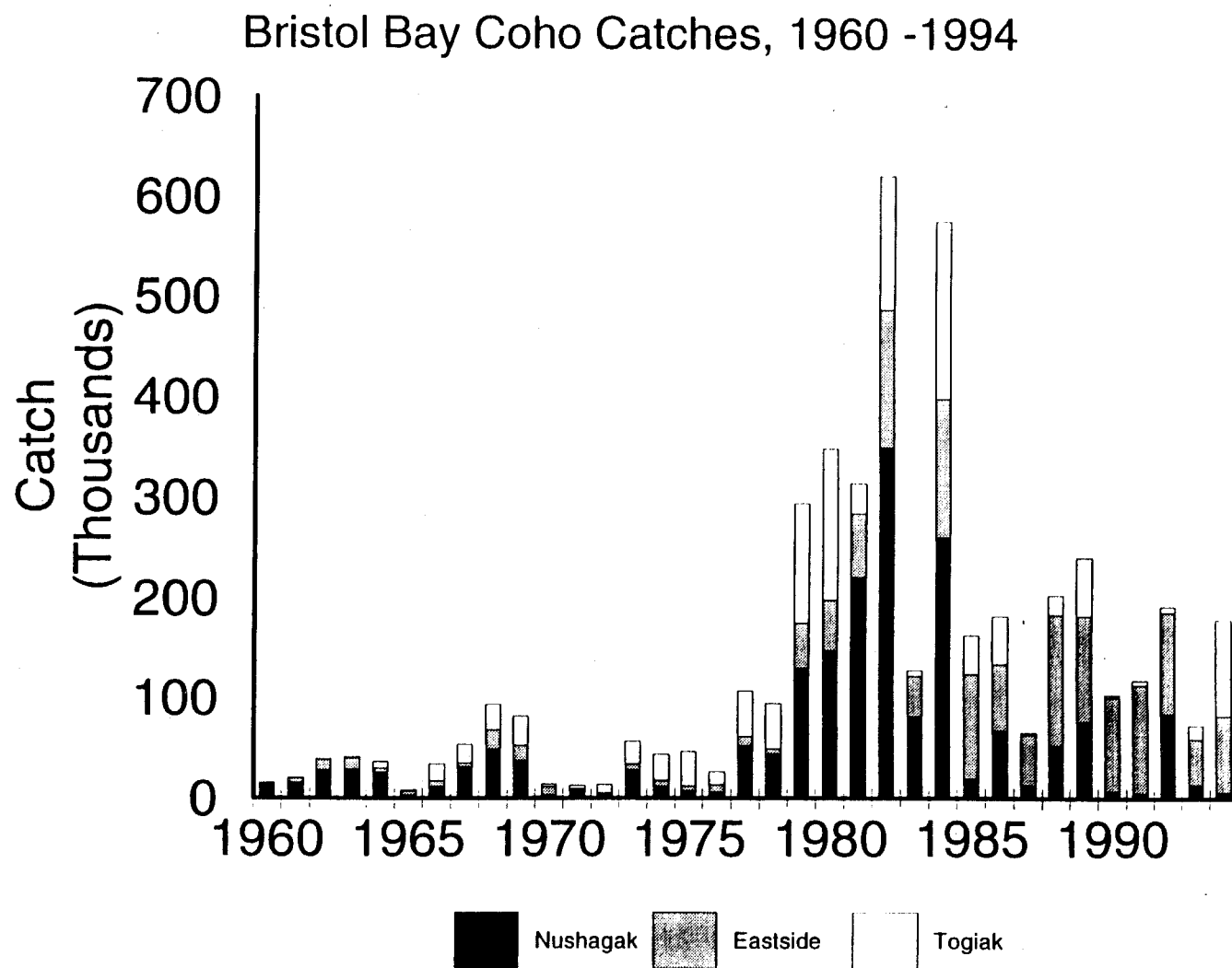


Figure 7. Coho salmon commercial catch in Bristol Bay, by district and year, 1960-1994.

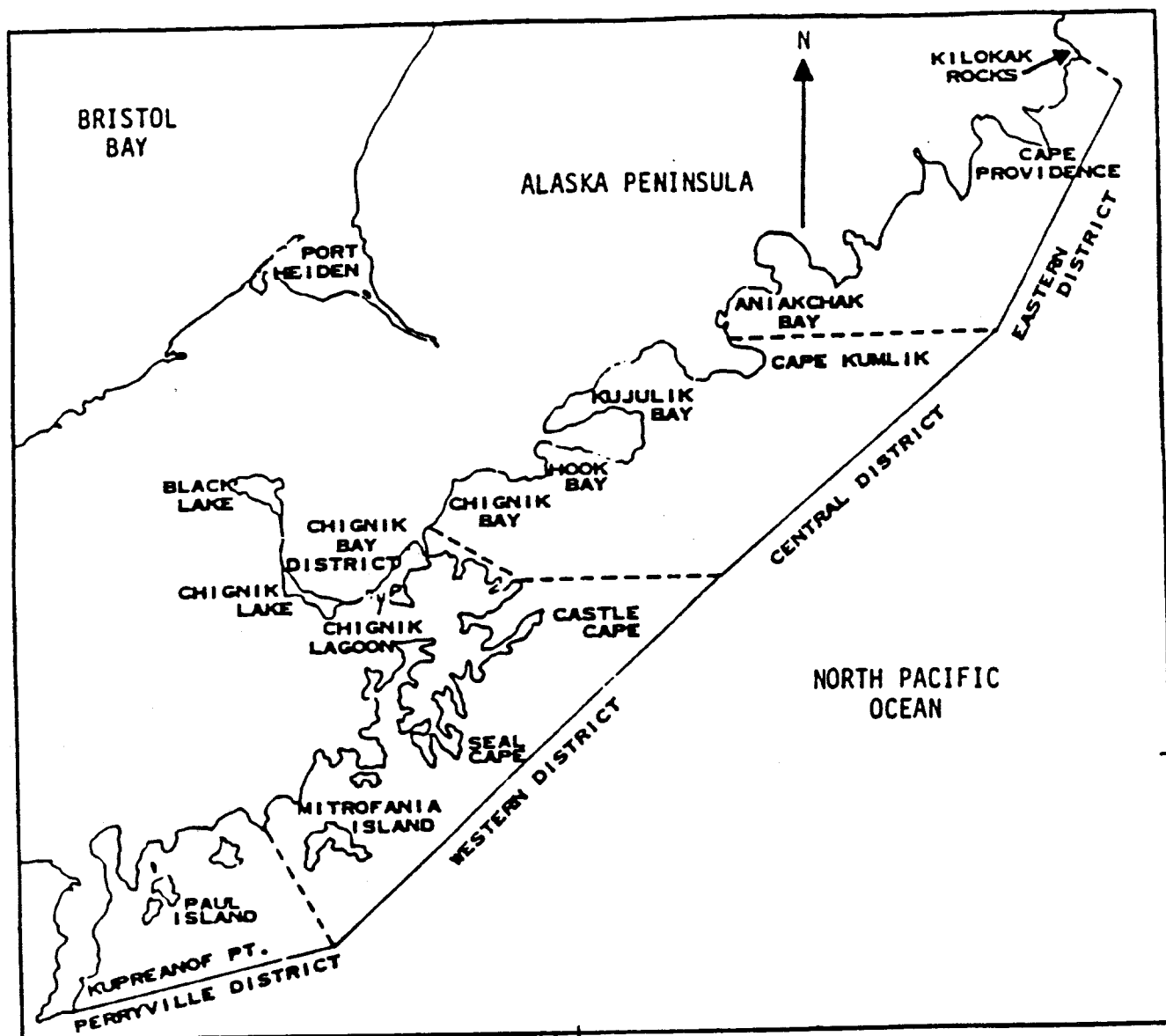


Figure 8. Map of the Chignik management area with statistical fishing districts and some prominent locations identified.

Kodiak Management Area Coho Catch

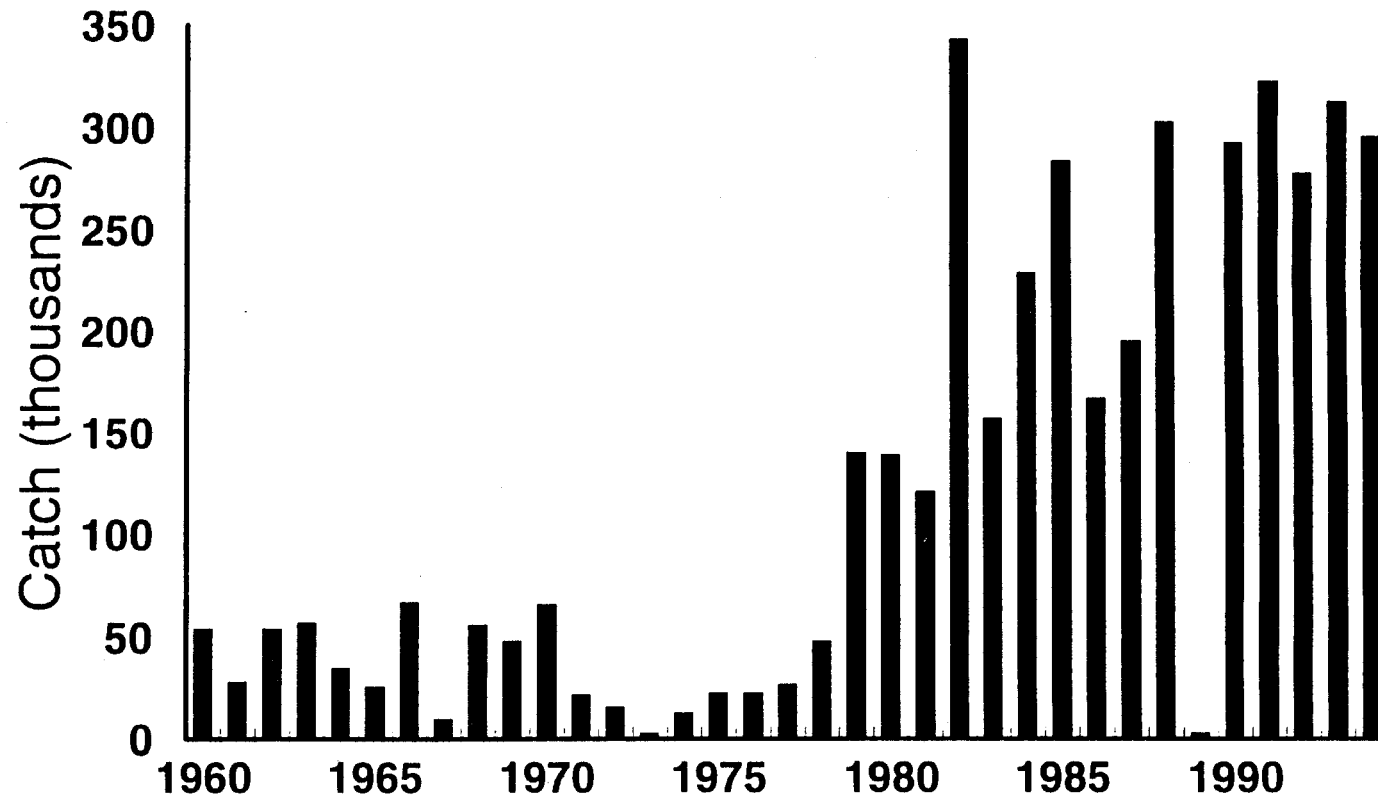


Figure 9. Coho salmon catch, 1960-1994, for the Kodiak management area.

South Peninsula Salmon Fisheries

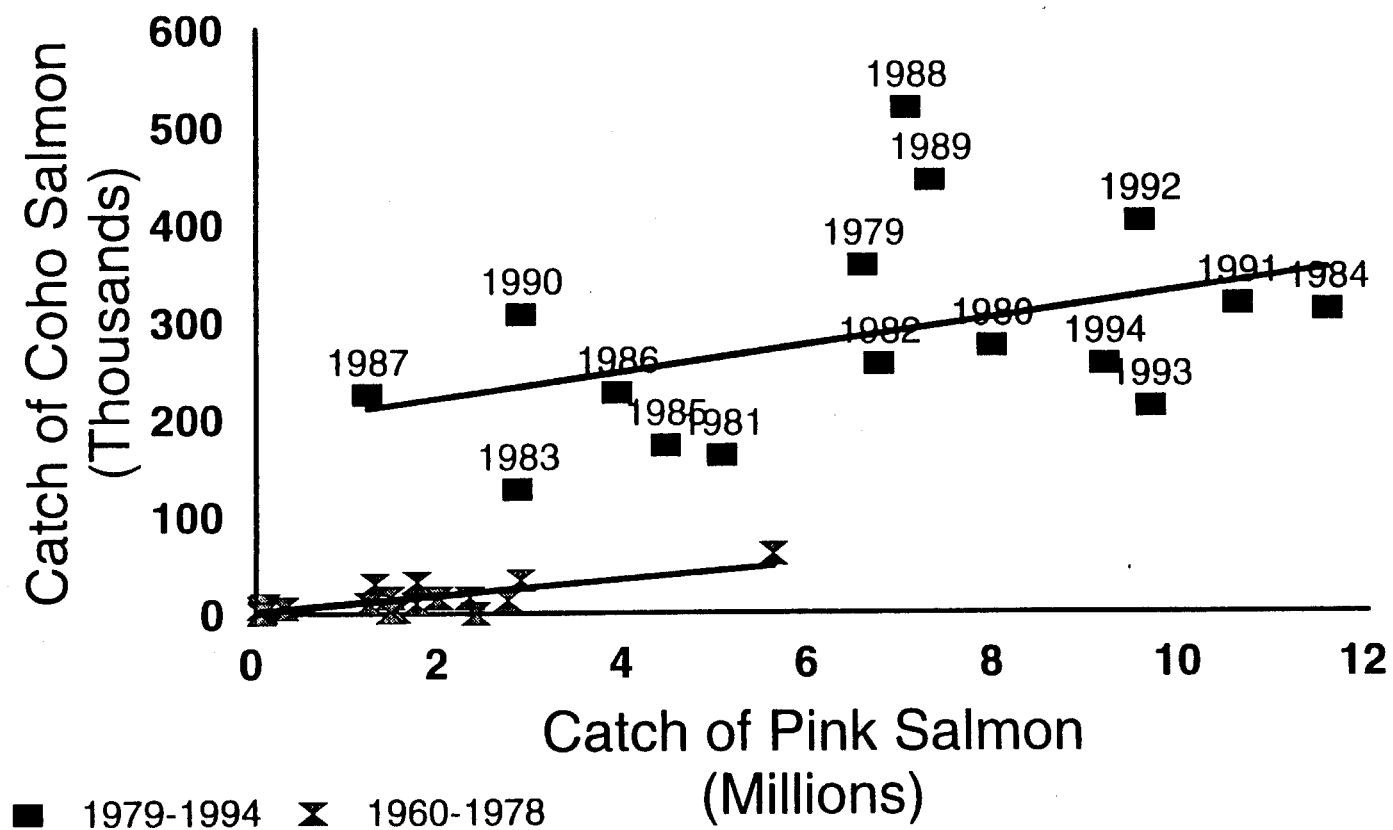


Figure 10. Relationship between total season catch of coho salmon and total season catch of pink salmon in the South Peninsula management area salmon fisheries.

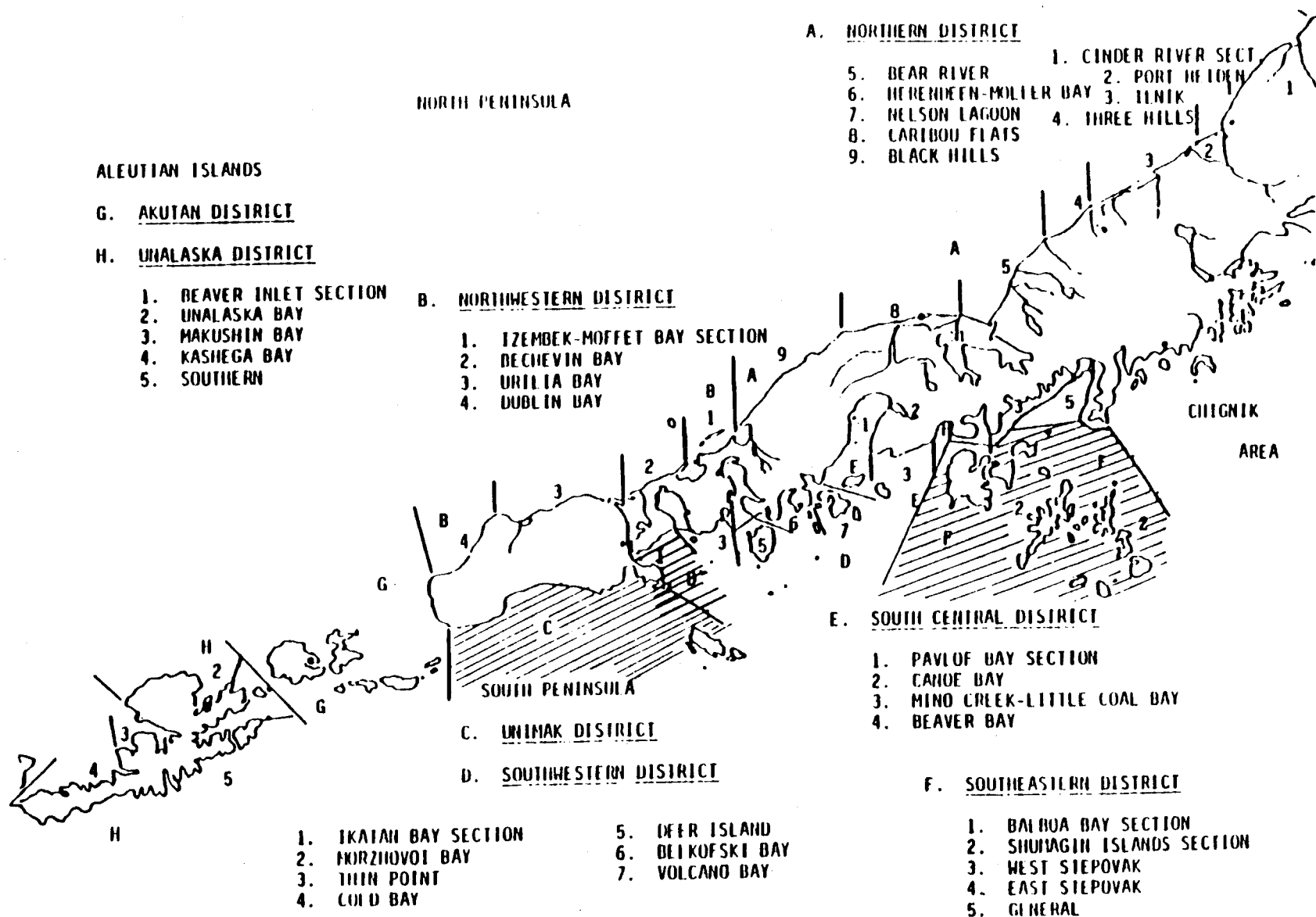


Figure 11. South Peninsula fishing districts (stippled area are the Ikutan Bay Section of the Southwestern District, Unimak District, and the Shumagin Section of the Southwestern District).

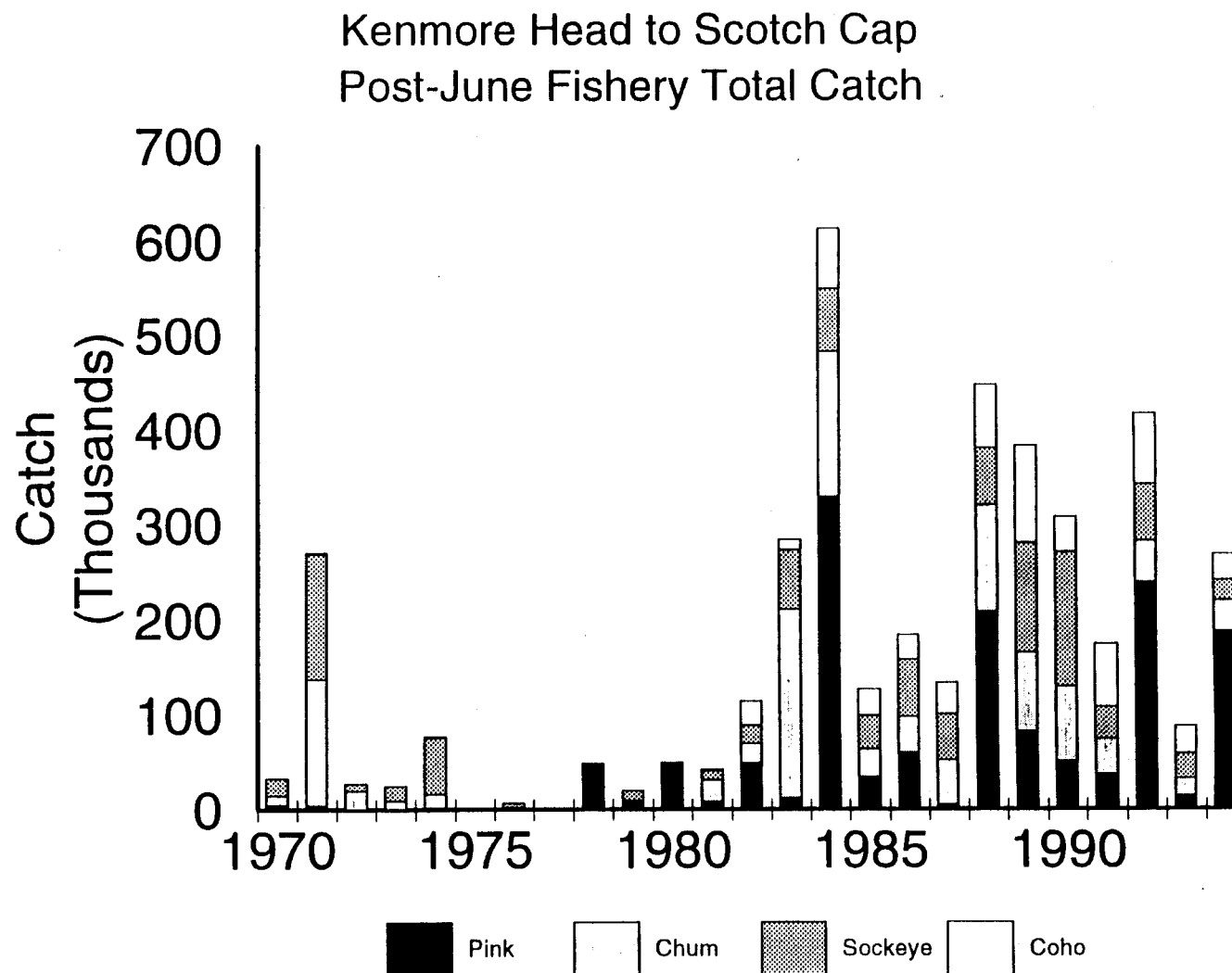


Figure 12. Commercial post-June salmon catch (thousands of fish) by species, 1979-1994, for the South Unimak area.

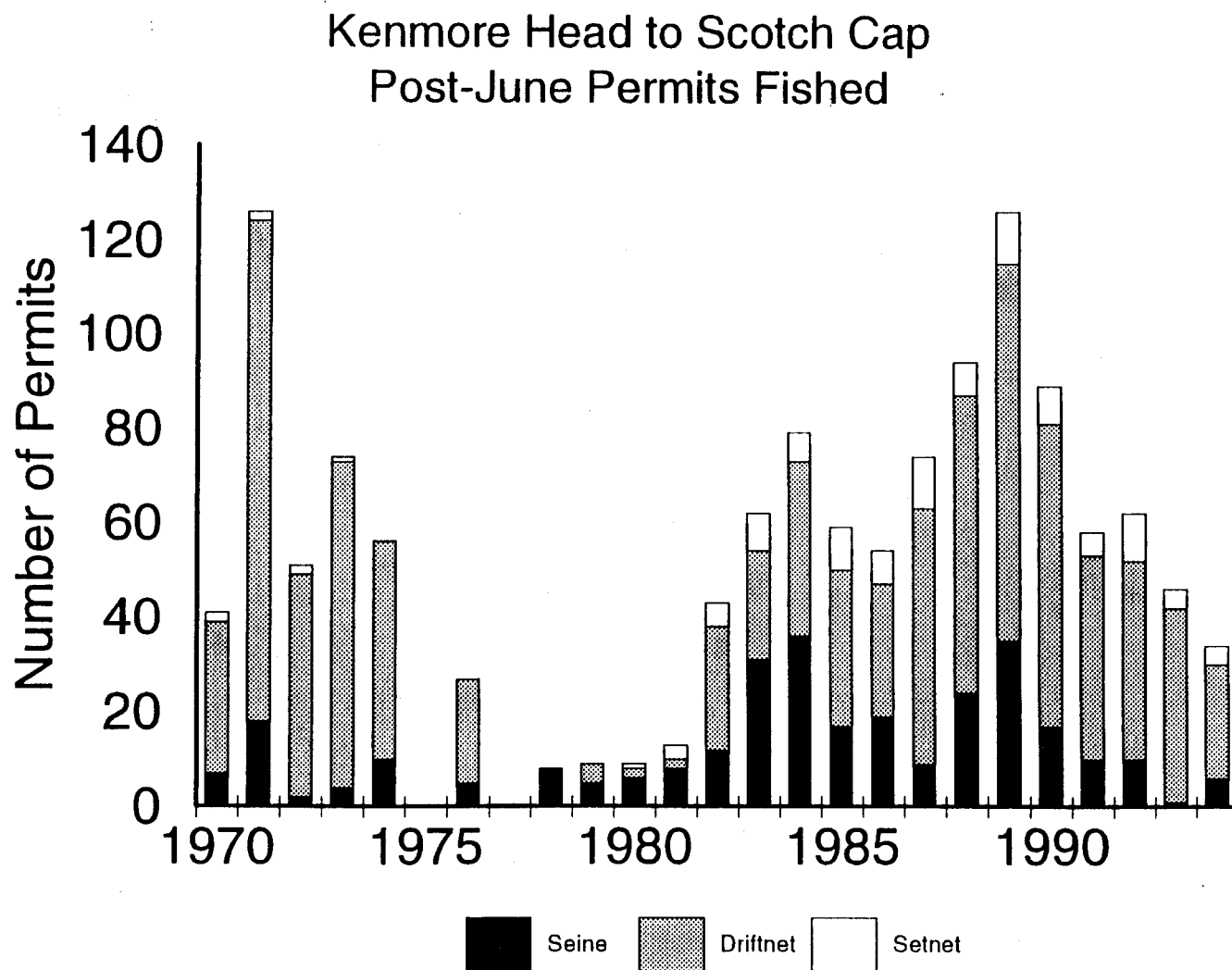


Figure 13. Fishing effort (number of vessels fishing) by setnet, purse seine, and driftnet gear, during post-June period for the South Unimak area, 1980-1990.

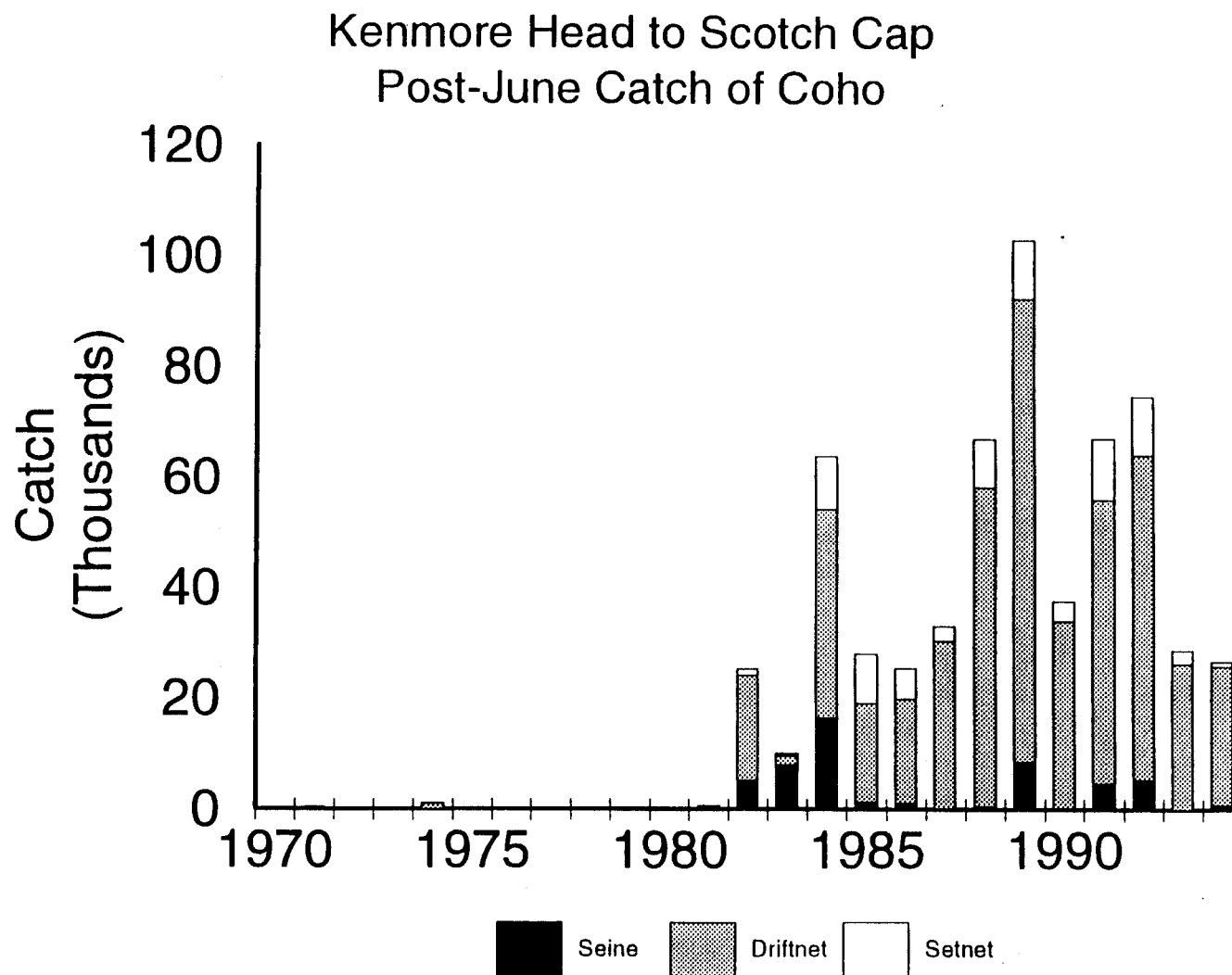


Figure 14. Catch of coho salmon (thousands of fish) by setnet, purse seine, and driftnet gear, during post-June period for the South Unimak area, 1980-1990.

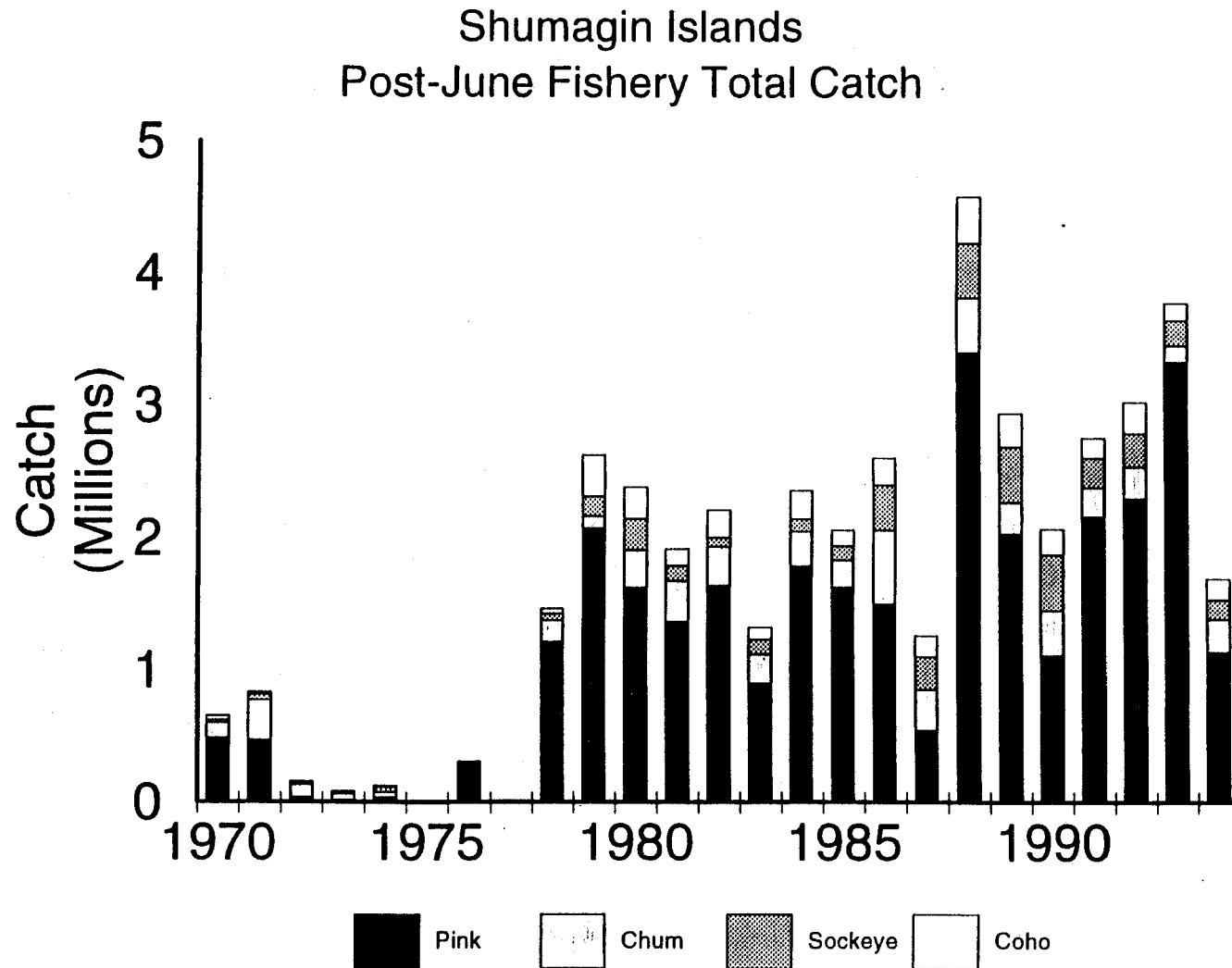


Figure 15. Commercial salmon catch during post-June period (thousands of fish) by species, 1979-1994, for the Shumagin Islands area.

Shumagin Islands Post-June Permits Fished

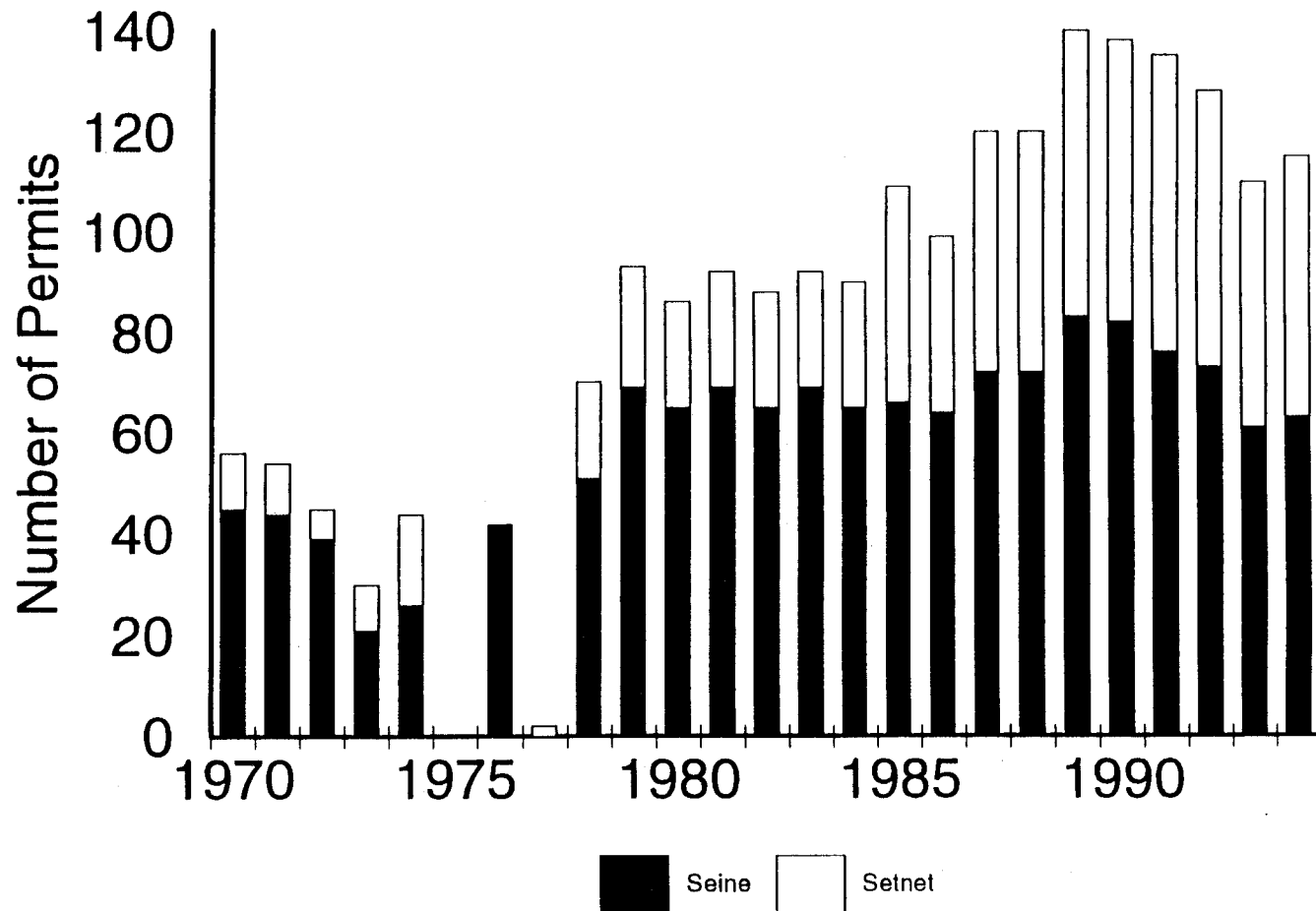


Figure 16. Purse seine and set gillnet fishing effort (number of vessels fishing) during post-June period, 1979-1989, for the Shumagin Islands area.

Shumagin Islands
Post-June Catch of Coho

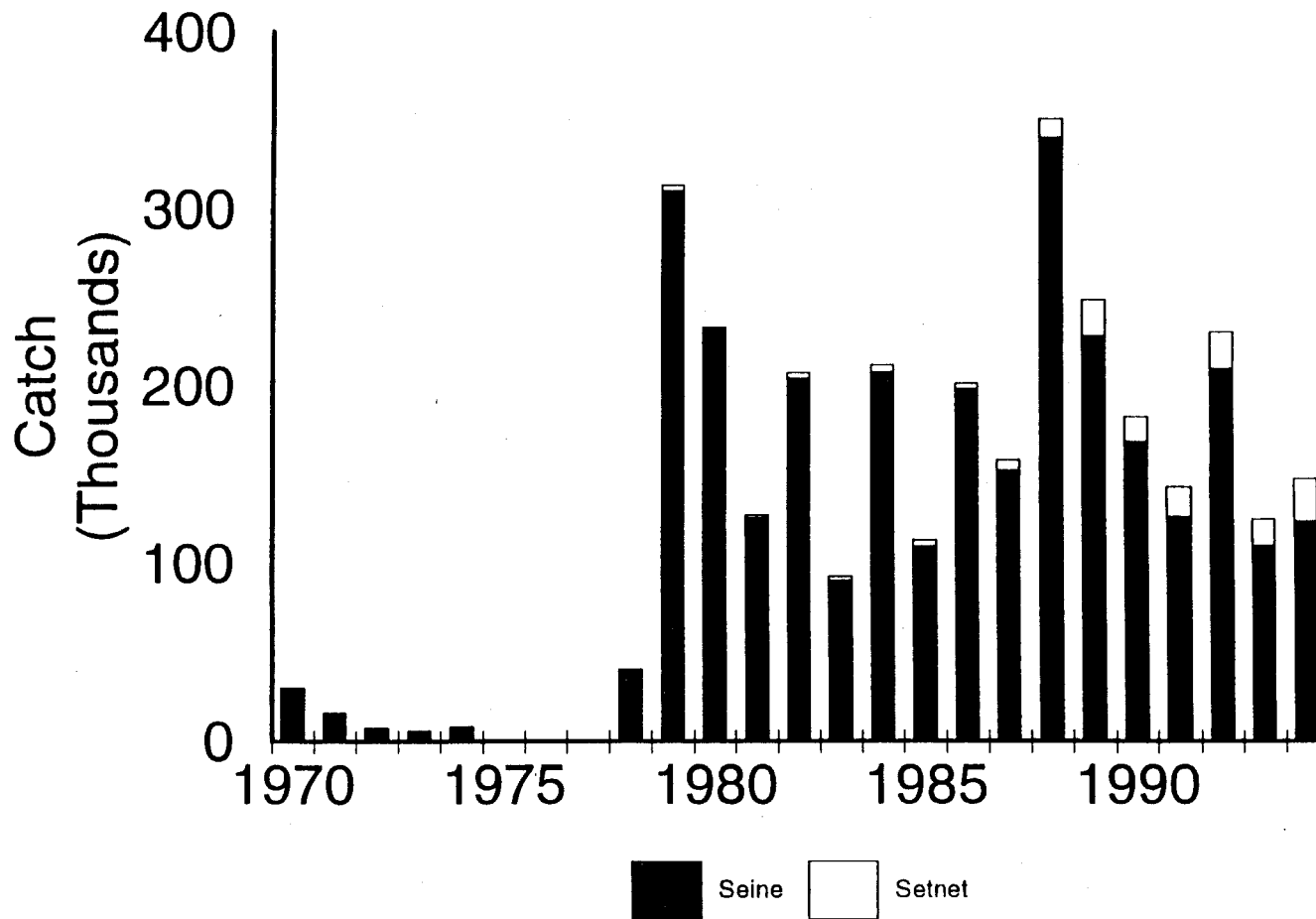


Figure 17. Purse seine and set gillnet catch of coho salmon (thousands of fish) during post-June period, 1979-1989, for the Shumagin Islands area.

Shumagin Islands Fishery Average Timing of Catch

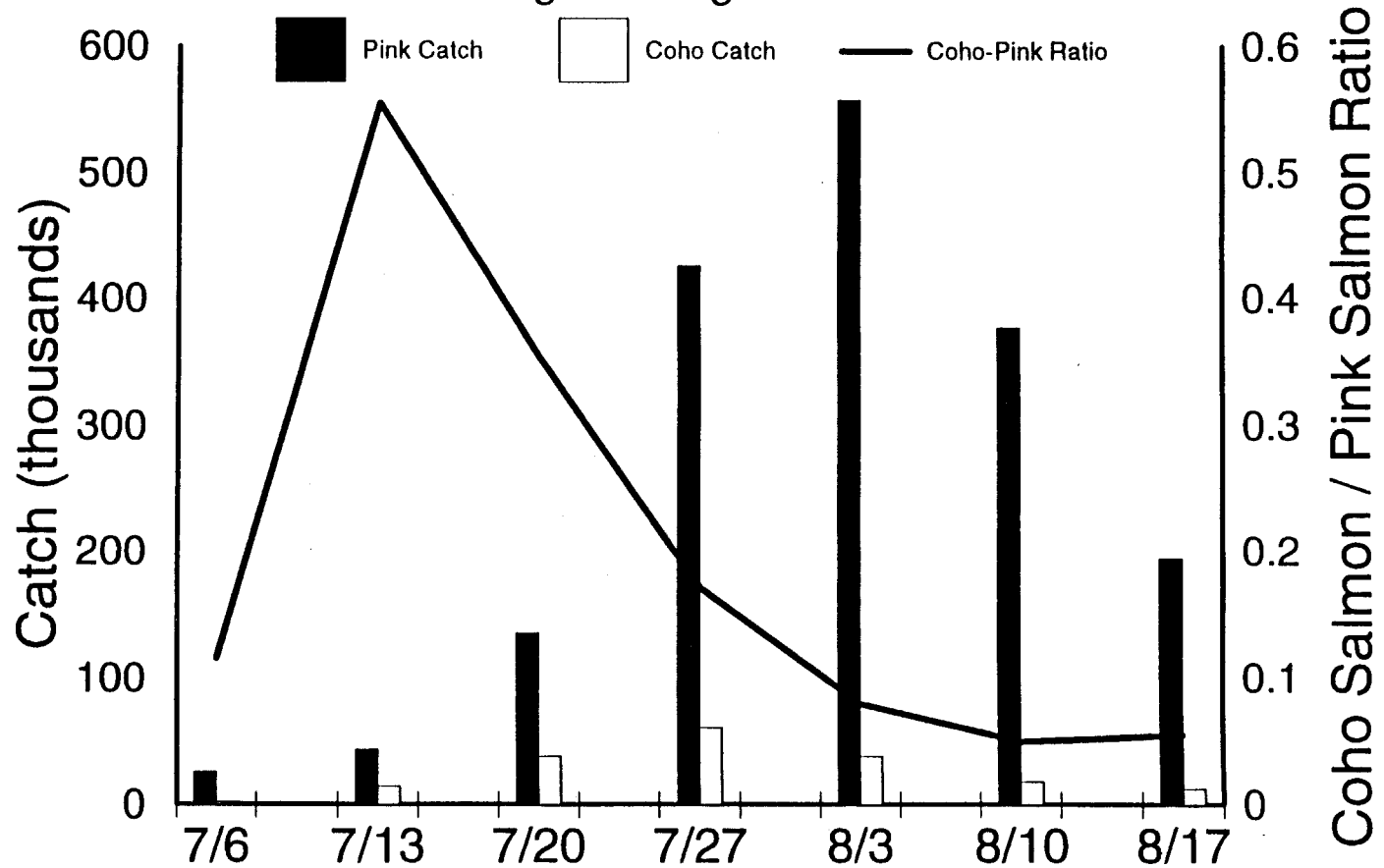


Figure 18. Average catch of coho salmon, average catch of pink salmon, and average ratio of coho and pink salmon in the catches, by statistical week, for the Shumagin Islands area. Note that averages are taken over years 1981-1994.

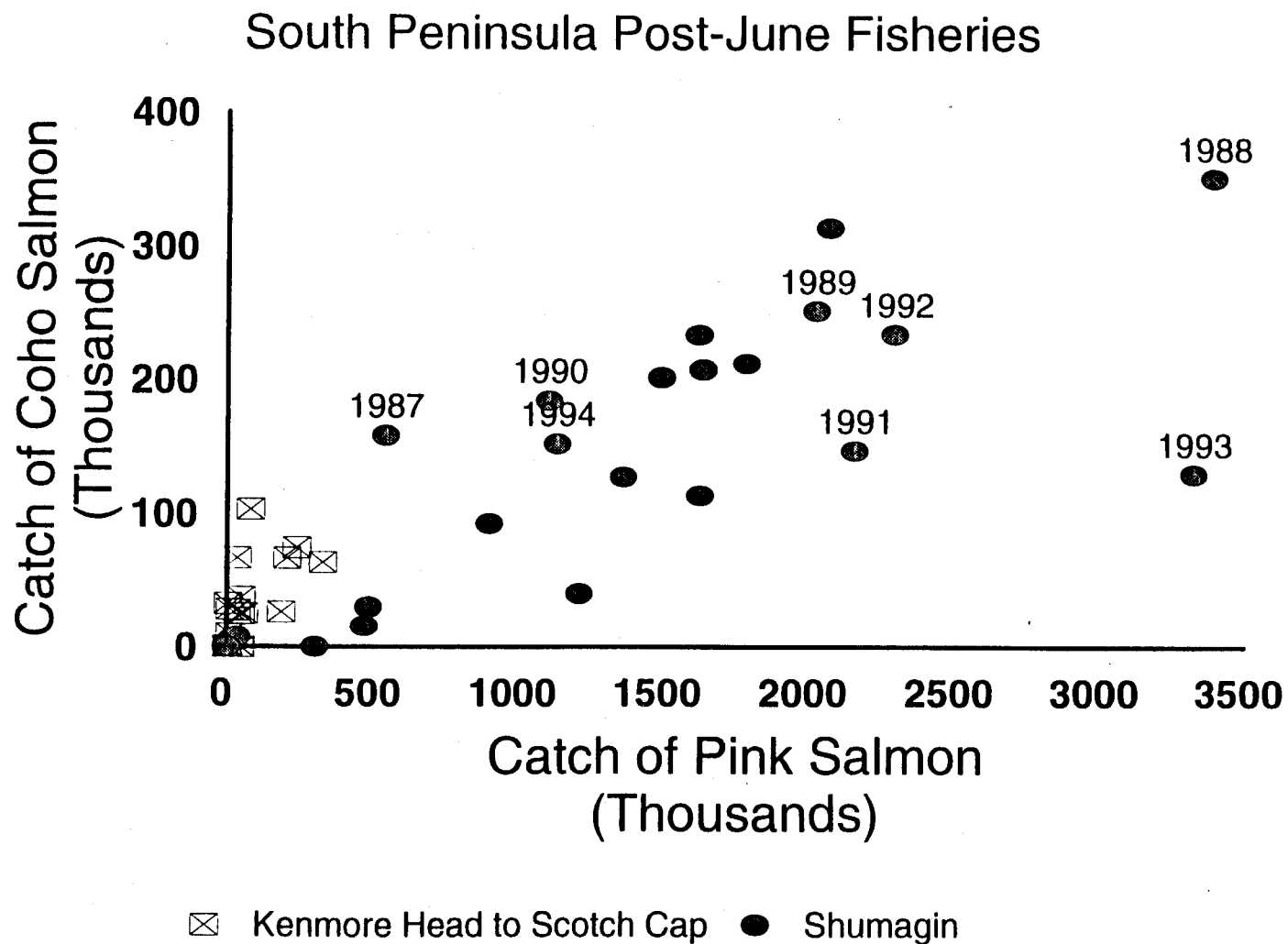


Figure 19. Relationship between catch of coho salmon and catch of pink salmon during July and August in the South Unimak and Shumagin Islands area salmon fisheries. Shown are years 1979-1994.

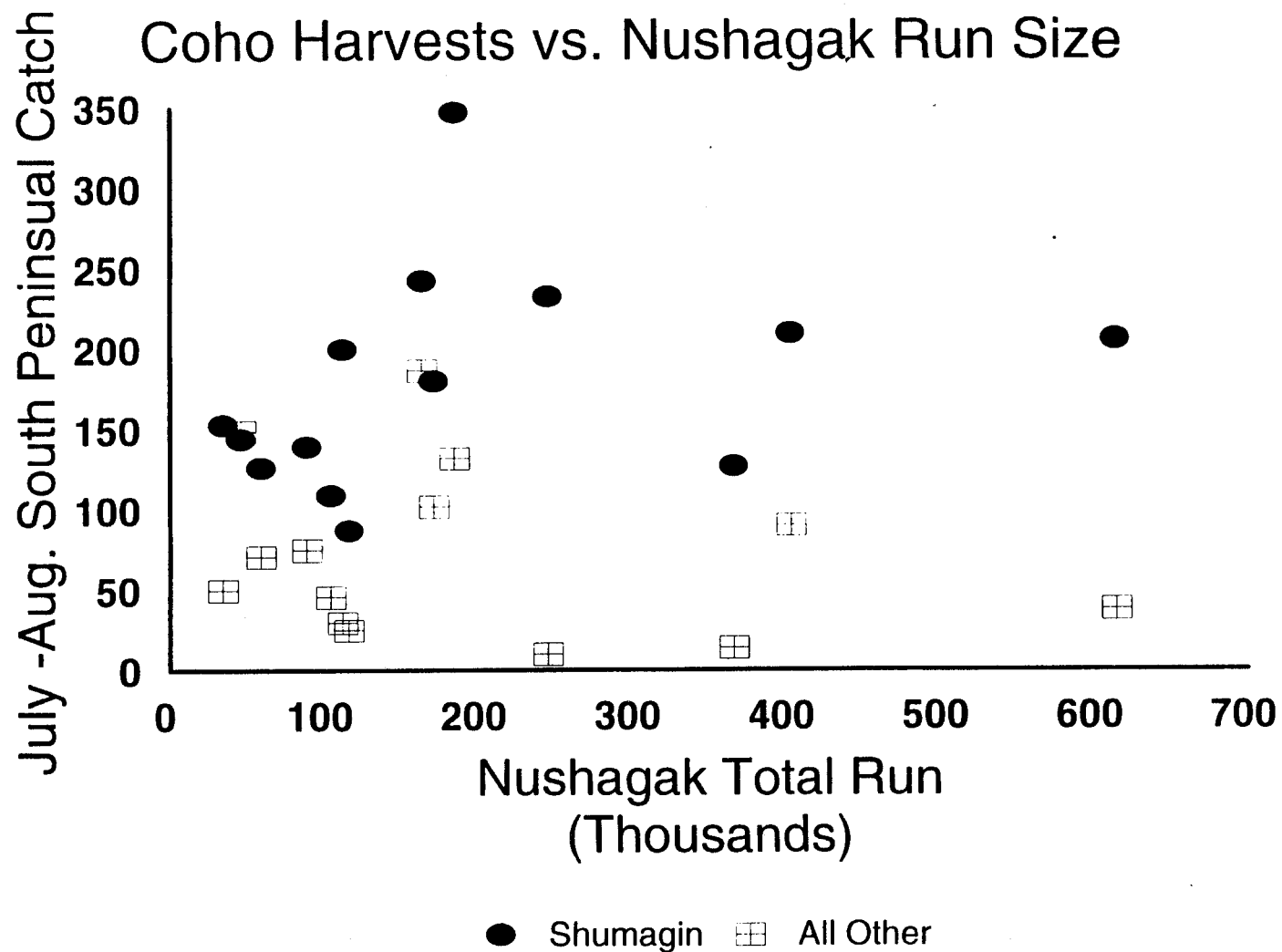


Figure 20. Relationship between estimated inshore run of Nushagak coho salmon and catch of coho salmon in July and August in South Peninsula fisheries. Data plotted are years 1979-1994.

Timing of Coho Salmon Catches in Western and Central Alaska Harvest Areas

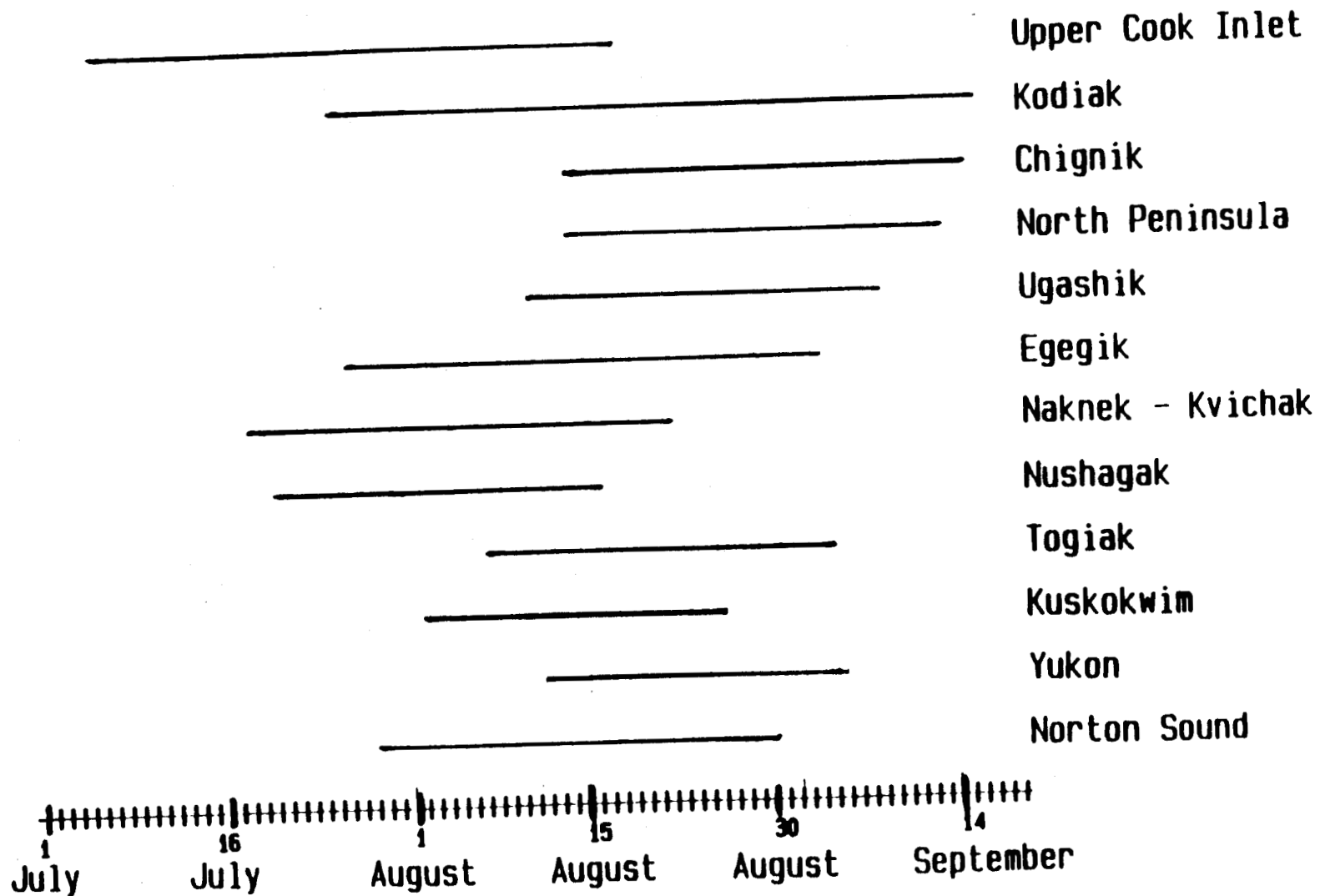


Figure 21. Timing of the central 90% of the commercial catch for various terminal harvest areas in western and central Alaska (from Eggers et al. 1991a).

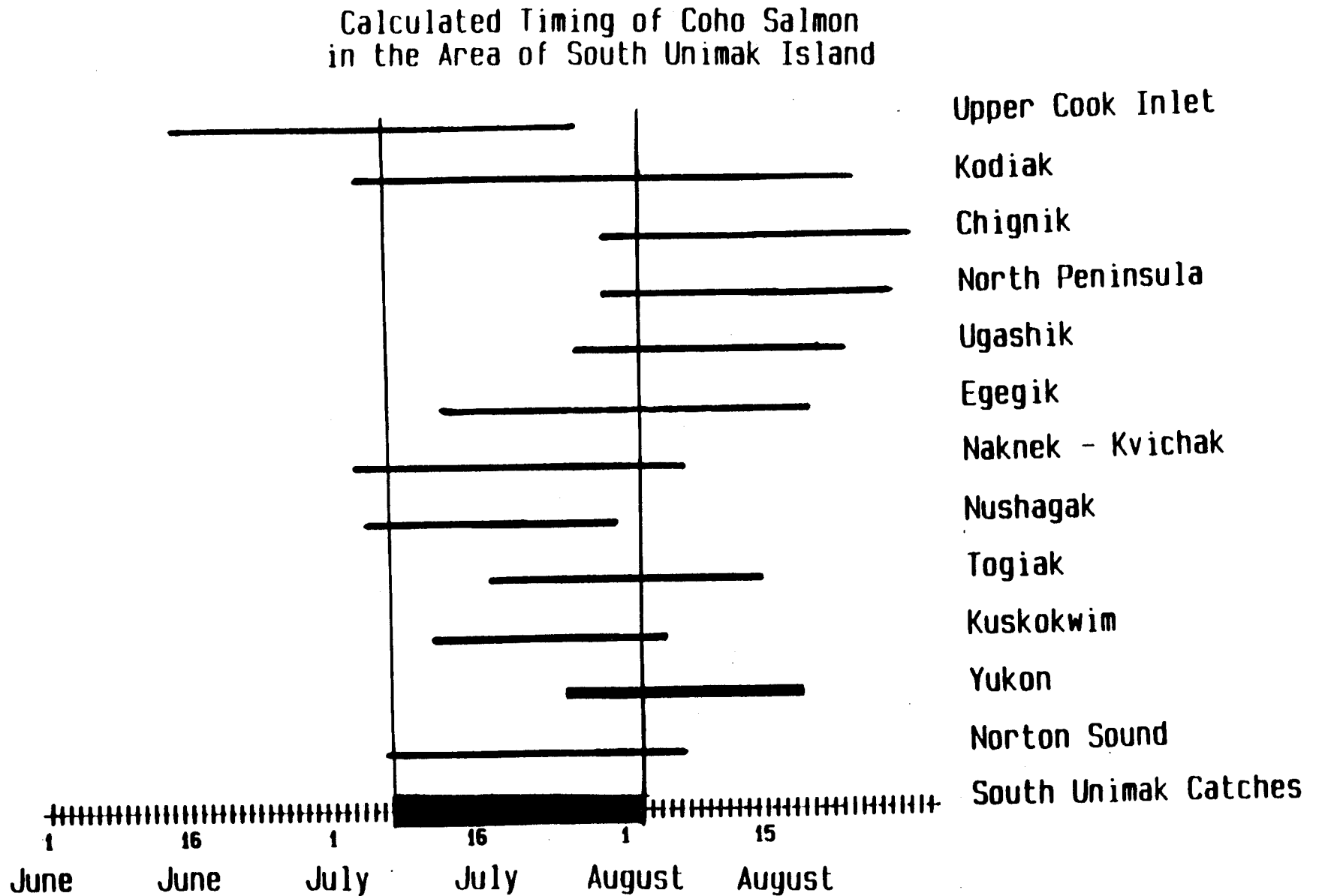


Figure 22. Calculated timing of the central 90% of the run in the South Unimak area for various western and central Alaska coho stocks (from Eggers et al. 1991a).

Calculated Timing of Coho Salmon in the Area of the Shumagin Islands

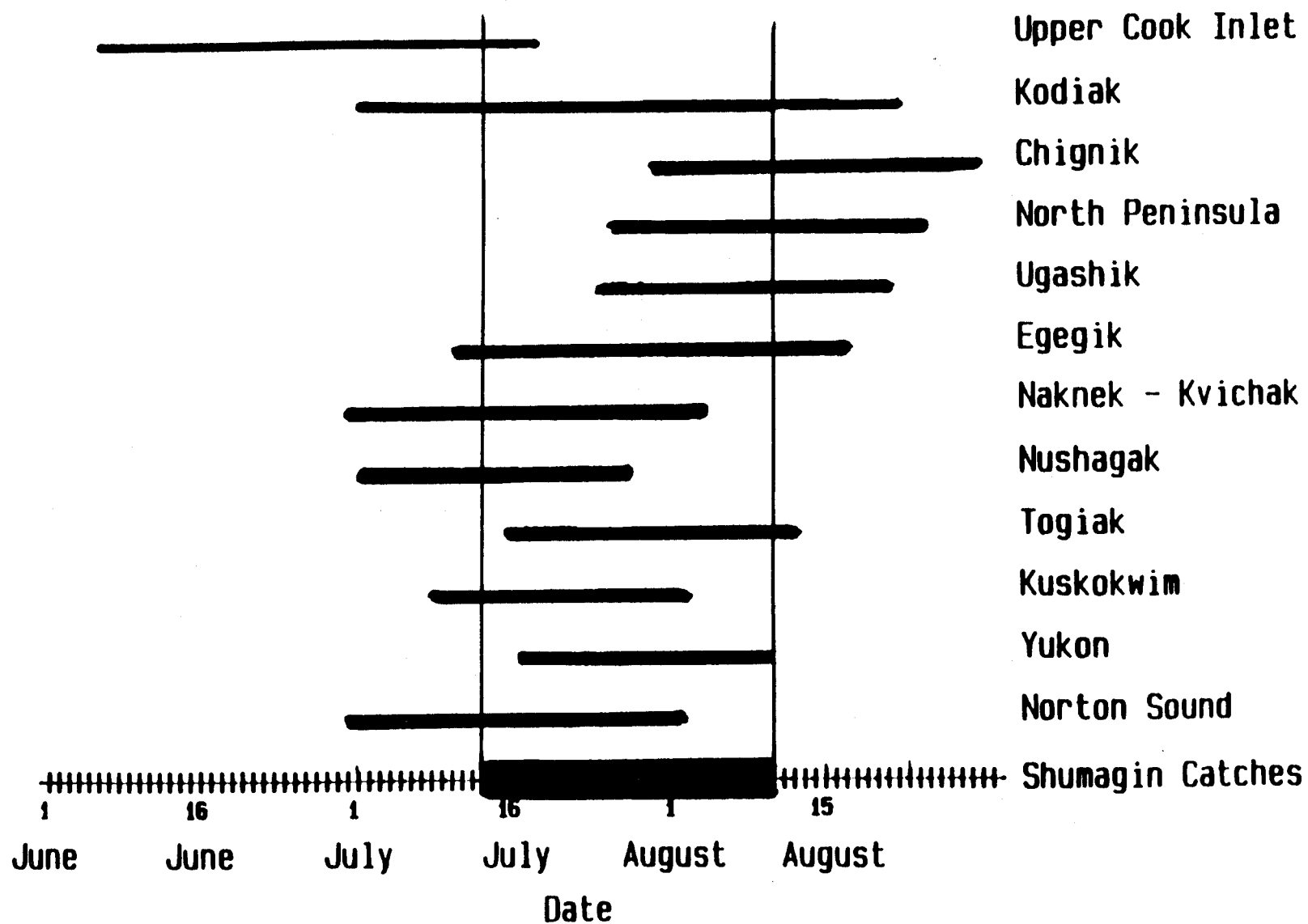


Figure 23. Calculated timing of the central 90% of the run in the Shumagin Islands area for various western and central Alaska coho stocks (from Eggers et al. 1991a).

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